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PUBLIC WORKS

City, County and State

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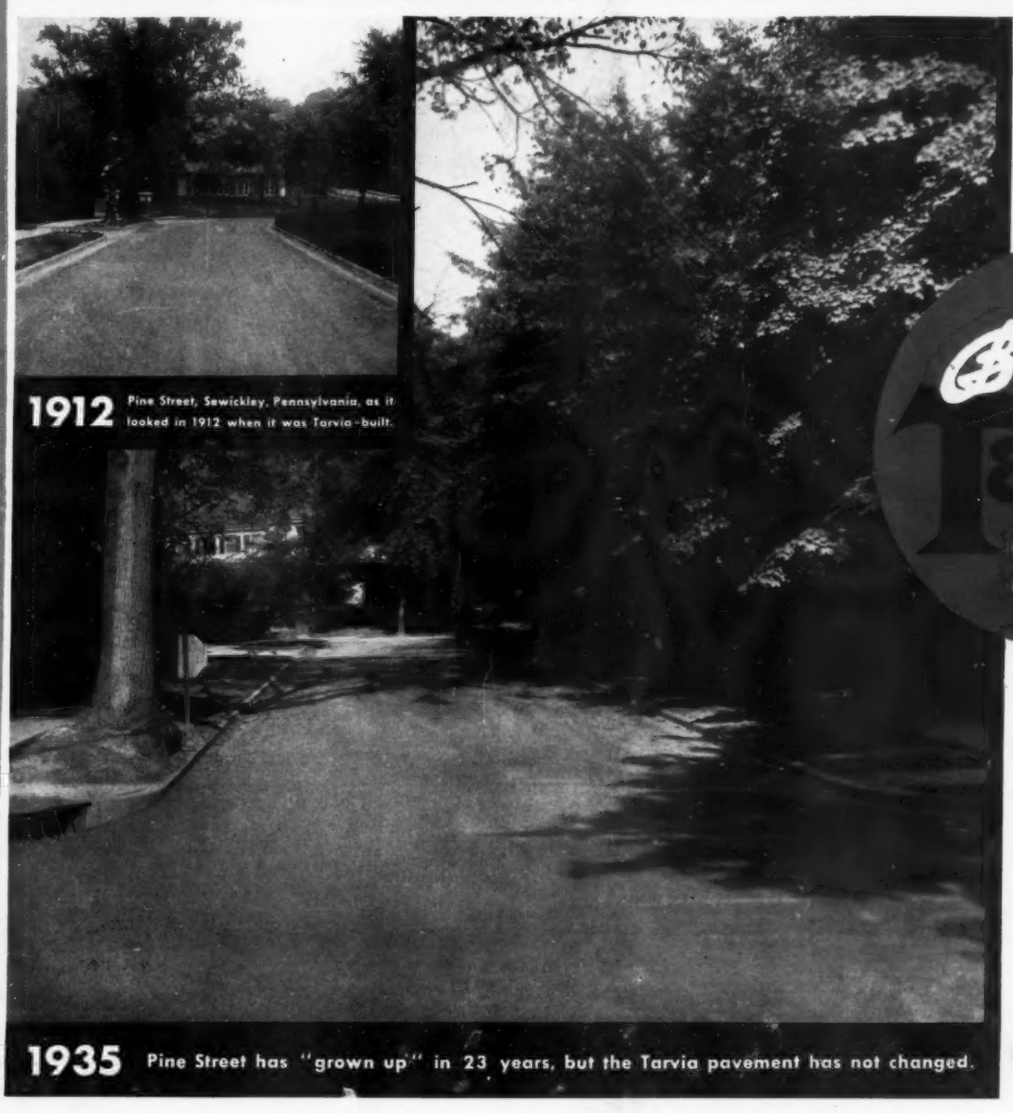
1912 Pine Street, Sewickley, Pennsylvania, as it looked in 1912 when it was Tarvia-built.
1935 Pine Street has "grown up" in 23 years, but the Tarvia pavement has not changed.
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JANUARY, 1935

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VOL. 66 PUBLIC WORKS NO. 1

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January 1935

PUBLIC WORKS

Vol. 66 No. 1

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TIMEWASTERS

That "ghi" Problem:

Several solutions have come in, and most of the sharks had to fall back on the old reliable table of squares. R. R. Hoops, of Ohio, worked out eleven conditions which eliminated all but 31 of the possibilities, and then found that both 567 and 854 met the requirements; Walter S. Wheeler also found both answers, and he says that it took him 10 minutes, using a table of squares. Fast work, oldtimer. Whitworth Cotten, from down in Virginia, and G. D. Houtman of Pennsylvania, were others with the 567 answer. W. O. Mason of Pennsylvania and George H. Whitfield of Virginia got both 567 and 854, and Edwin M. Brady of Indiana turned in 854.

Kids, Skirts and Pants:

And Mr. Houtman sends in a nice solution to the problem in the November issue on movie attendance, along with a letter saying that he lost three vest buttons when we tabbed him as a real shark. Well, here's his solution:

X (kids) + y (skirts) + z (pants) = 100, and
$x + 20y + 50z = 1000$
and by combining, $19x - 30z = 1000$
Therefore $z = [1.9x - 100] \div 3$

Since 1.9 x must exceed 100, x must exceed 60, and may be 60, 70, 80 or 90. Also $1.9x = 100$ must be a multiple of 3. No other number than 70 will work. Therefore, we have 70 kids, 11 skirts and 19 pants.

—Q. E. D.

One from the "Book:"

Who is the smallest man mentioned in the Bible? The slide rule won't tell; it takes good bringing up to answer this one.

Too Much for Us:

Mr. Houtman points out that

$1^3 + 2^3 + 3^3 \ldots + n^3 = (1+2+3 \ldots + n)^2$

and remarks casually that this is a relation he has noticed but never saw proved. Now who can prove it?

Down to the Last Copper:

How many miles of wire 1 mil (one-thousandth part of an inch) in diameter can be drawn from 1 ounce of copper? (The specific gravity of drawn copper is 8.9). *Walter S. Wheeler.*

Help!

The pot is boiling low and a few good problems to make the sharks sit up these long dark nights are requested. Small contributions gratefully received. Happy New Year to all.

—WAH

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A. PRESCOTT FOLWELL, *Editor* **W. A. HARDENBERGH,** *Asso. Editor*

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It pays to Switch to 'Incor'

Why not figure these savings. It has paid many contractors to switch to 'Incor' with the coming of Winter. Example: In constructing the Administration Building and Hangar for the 26th Div. Massachusetts National Guard, shown above, the engineer says:

"January temperatures were below freezing and building site very much exposed. To reduce danger of freezing, I recommended that the contractor use 'Incor' Cement. Materials were heated and salamanders used after concrete was poured. 72 hours' protection requirement was reduced to 36 hours. Earlier removal of forms saved much lumber; but the real reason for using 'Incor' was to reduce freezing hazards."

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When you need special information—consult the *classified* READERS' SERVICE DEPT., pages 63-65.

PUBLIC WORKS

City, County and State Engineering and Construction

Vol. 66 *January, 1935* No. 1

Delayed traffic in Cook Co., Ill.: Western Avenue near 75th Street before grade separation

Rail-Highway Grade Crossing Elimination

EVERY one of the 237,000 existing rail-highway grade crossings in the United States is a source of potential danger and delay to the highway user. Regardless of the protective measures afforded, no grade crossing is safe; and delay, with its resultant economic loss, becomes important on heavily traveled main routes and on major city streets. Complete safety and prevention of delay can only be secured by the elimination of grade crossings, either by relocation of the highway or a separation of grades.

The benefits resulting from such elimination have generally been considered as being divided equally between the general public and the railroads, and it therefore has appeared reasonable to proportion the cost on the same basis. Most states have by either law or precedent, fixed 50% as the amount of the cost to be borne by the railroads.

For this reason the railroads have been openly opposed to any extensive program of grade crossing elimination. They admit that the separation of grades is beneficial to them but contend that the assessed costs are not in proportion to the benefits received by them. They have also maintained their financial inability to pay for any extensive or even moderate program of grade crossing elimination.

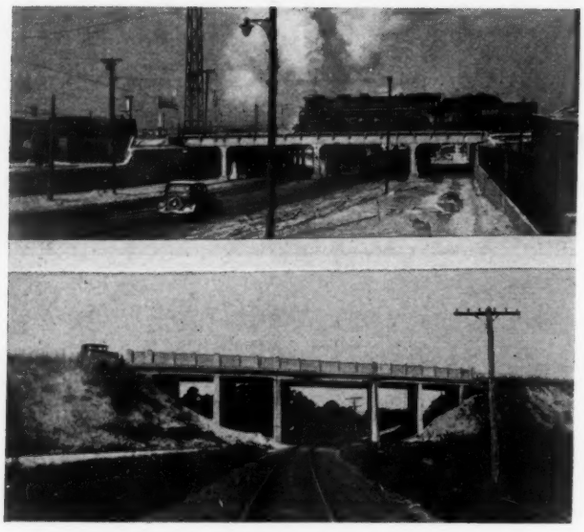
In all fairness to the railroads it must be said that there is some justification for their stand. Accidents at grade crossings have increased during the past few years, while the actual number of trains operated by the railroads has been less. It is evident that the increase in accidents has been due largely to an increased use of the motor car, and therefore the public should pay a larger proportion of the cost. Moreover, with the revenues of the railroads steadily decreasing during the last few years, it is not a question of how much they *should* pay but rather how much they *can* pay.

In the past, this division of cost has been the largest single factor in the curtailment of an adequate program of grade crossing elimination. That a more liberal policy in regard to the division of cost should be adopted is fast gaining popular support. Thos. H. MacDonald, Chief of the Bureau of Public Roads in a recent address said:

"State laws governing the financial responsibility of the railroads for cost participation in grade crossing elimination are in general a heritage of the past. As a rough approximation, the railroads' share as fixed by, or under, these laws, may be placed at 50 per cent. These laws now are an effective stop order on such improvements. While it is not invariably true, the margin is so narrow that practically it may be said that unless financing is supplied in major part by the public, there will be no adequate advance in these major traffic facilities for as long as we can now see into the future. This winter the laws in most of the States should be revised to make wholly flexible and more liberal public financing possible and relieve the railroads from any fixed percentages of cost contribution."

While such a policy is desirable for the future, the fact remains that even if such laws were repealed this coming winter, that would not in itself stimulate a large program of grade crossing reduction. For at present, most cities, counties and states are operating on reduced budgets, current revenues are in most cases obligated and bond issues are unpopular.

In view of the fact that the Federal Government is planning large expenditures for the relief of the unemployed, it has been suggested that a certain portion of these funds be set aside for the construction of rail-highway separation projects. It is maintained (1) that such work can be placed under contract quickly, (2) that it will provide more hours of work per $100 expenditure than any other type of construction; (3) that it will provide this work where it is most needed, around congested centers of population; (4) that the materials required will stimulate the lagging heavy goods industries; (5) that it will aid the railroads to increase



Above—Grade separation replacing condition shown on page 9
Below—A New Jersey highway crossing the Reading Railroad

speed of railroad operation, thus opening the way for a revival of this essential form of transportation.

It has been estimated that approximately 50% of all grade crossing accidents occur at 5% of the crossings. Since there are some 237,000 crossings in the United States, the cost of eliminating 5%, assuming an average cost of $40,000 per structure, would amount roughly to $500,000,000.

With a record last year of 4,310 accidents at grade crossings, resulting in loss of 1,360 lives and the injury of 4,430 persons, and with the record this year exceeding last; and with the elimination of all delay to both rail and highway traffic by grade crossing elimination, this estimated cost would seem to be a real economy.

Cotton Mats for Curing and Preventing Freezing of Concrete

The Bureau of Public Roads has studied the use of cotton mats for curing concrete pavements and preventing freezing thereof. These mats are made of cotton fiber held in place between sheets of loosely woven covering cloth by stitching or tying. Six weights were tested: A-10 oz. per square yard; B-30 oz.; C-60 oz.; D-90 oz.; E-110 oz.; F-170 oz. In the curing tests, some of the mats were used dry, others were thoroughly wet; and the results were compared with those from use of burlap kept wet for 3 days by repeated sprinkling or other application of water.

In curing, the conclusion was reached that when dry cotton mats were used, the 28-day strength was only 88% of that reached when the wet burlap was used. During the 3-day curing period, the concrete covered with dry cotton lost 7% of its original water content; that covered with wet burlap gained 5%. With wet cotton mats the results were approximately the same as with wet burlap; a little less gain with the thin mats, a little more with the thicker ones. The advantages of the cotton mats is that they have to be wet but once; the burlap has to be wet frequently during the first three days.

In preventing freezing by heat loss at night, the tests made "indicate that, for an overnight drop of air temperature to below 32° F., a considerable amount of protection against damage from freezing can be afforded a concrete paving slab by covering with a cotton-filled mat of relatively light weight." Even the lighest-weight mat seemed to furnish more protection than either dry double burlap or a 2″ layer of practically dry earth, but 4″ of dry loose straw was better than the thinner cotton mats, though less effective than the thickest ones.

A Concrete Bridge by LWD Labor

The bridge shown in the accompanying before-and-after pictures (the latter taken December 17th) was constructed by Upper Darby township, Pennsylvania, as one of nine L. W. D. projects.

The bridge has a span of 16 feet and is 40 feet wide. The total cost was $5,747.52, which includes two 12-foot approach slabs of reinforced concrete 10 inches thick and 24 feet wide. The itemized costs were as follows:

Labor contributed by L.W.D.		$3304.69
Material contributed by Township—		
Premixed concrete—151 5/6 yards	$1252.13	
Form lumber	330.23	
Reinforcing bars	198.29	
Truck & pump rental	143.00	
Inspector's wages	243.00	
Engineering	100.00	
Miscellaneous (includes tools)	176.18	2442.83
Total		$5747.52

We are indebted to Wm. W. Reeder for the information and photographs.

"Before and after" of an LWD constructed bridge

Spring-tooth and Acme harrows in tandem.

A Rhode Island Experimental Tar Project

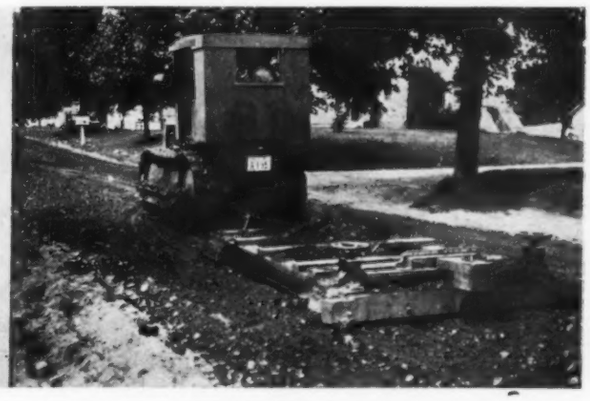
IN the summer of 1933 Daniel A. Soule, maintenance engineer of the Rhode Island State Board of Public Roads, constructed an experimental stretch of tar mixed-in-place surfacing on a three-mile section of earth road located between Exeter and North Kingston. The road in question was a country road about 12-14 feet wide, on which travel was impossible in the spring when frost was coming out of the ground, as machines and vehicles were mired in mud hub deep. The surfacing material in the road consisted of natural soil, such as loam, sand, clay and such gravel as local town surveyors had dumped into the holes and troublesome spots from time to time.

It was Mr. Soule's idea to widen the road surface to 18 feet with 5-foot shoulders on each side, and then scarify the widened surface and mix it with tar, without the addition of new gravel. It was felt that this type of construction with possibly a little maintenance, would keep traffic out of the mud, and eliminate spending the money which would be necessary for a higher type of pavement. Also, that this type of construction would stabilize the present roadway and make a base for a higher type of surface at a later date when more funds were available.

The road project was definitely divided into thirds by intersecting highways, and the State gave one-third of the project to each of three different tar companies, with the understanding that each of these companies was to send an engineer to supervise the work, and would be permitted to use whatever grade of tar they thought most suitable for the project, the only restriction being that they were to be limited to one gallon per square yard for the mixing course.

Construction work was started on August 14, 1933. The old road was widened to the desired width, blading all sod to the edge of the road. The soil was then scarified to a depth of 6", after which a power grader was used to blade the material horizontally and lengthwise, so as to obtain the proper cross section and the best possible grades to take care of drainage. After widening and shaping the road, the surface was loosened to a depth of 2½", to which was applied ½ gallon of tar, having a specific viscosity of 25-35 at 40°C. The tar and aggregate were then mixed by means of an Acme and a spring tooth harrow, hooked up in tandem behind a truck or tractor. After harrowing, another application of tar with a specific viscosity of 16-26 at 50°C. was applied at the rate of ½ gallon per square yard,

First application of tar harrowed in.



Mulching the top.

After first rolling.

Finished mixed-in-place surface.

and the same method of mixing followed, harrowing the aggregate until it was thoroughly coated with tar. After mixing, a Hallowell road hone was used to further mix the tar and aggregate and shape the road. This was followed by a 3-blade road machine which was used to smooth out any remaining ridges in the road surface. A three-wheel 12-ton roller was then used to compact the surface.

The road was opened to traffic for a period of two weeks, after which it was seal-coated with 1/3 gallon application of tar (spec. visc. 16-26 at 50°C.), and covered with sand, which was dragged, traffic being allowed to iron out the seal coat.

The road has been watched closely since the time of construction, particular attention being paid to its condition during the winter and spring months. During this period less than two cubic yards of cold patch material have been required to take care of the breaks in the entire three miles. It was interesting to observe that during the spring months, when the frost was coming out of the ground, no failures occurred, even under heavy traffic. This was possibly due to the fact that many longitudinal hair cracks had developed in the surface, through which weeping took place. No section of the road has been seal coated since construction but in all probability it will receive a seal coat before winter.

The actual cost for constructing this project, as furnished by Mr. Soule, is given below:

Labor and supervision	$2,390.24
Material (sand and gravel)	58.55
Machinery and operation	2,897.60
Tar	4,330.33
TOTAL	$9,676.72

The total length of the road is 2.86 miles.

From the above it is seen that the labor and supervision charge is rather high. This was due to the fact that no particular effort was made to limit the amount of labor used, as it was an experimental project, and in view of the unemployment situation. As no additional aggregate was used in the mix, the charge for material (sand and gravel) is low, this item being for the cover material used for the seal coat. The machinery and operation item includes Rhode Island's charges for machinery and equipment on a per diem basis, including operating costs, depreciation and insurance.

From the above figures it is seen that this project was constructed for a cost of $3,383.50 per mile, or 32.7c per square yard. This certainly is a reasonable cost for any type of highway that has to carry any amount of traffic, especially in a farming community.

The photographs used for illustrating this article were furnished by the courtesy of Koppers Products Co.

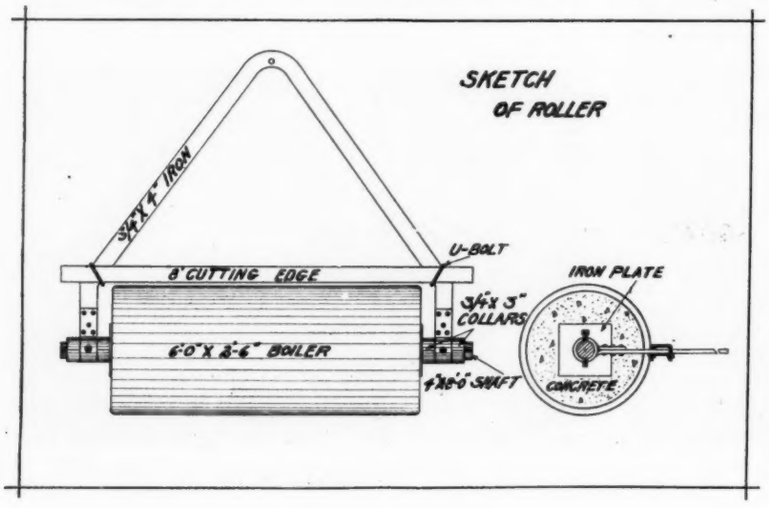
An Inexpensive Roller

By John Arneson
City Engineer, Fergus Falls, Minn.

SEVERAL months ago, Street Commissioner Thore Glende and the writer were working at certain FERA jobs for which we needed a roller badly. We knew it was out of the question to buy one, so we decided to make one.

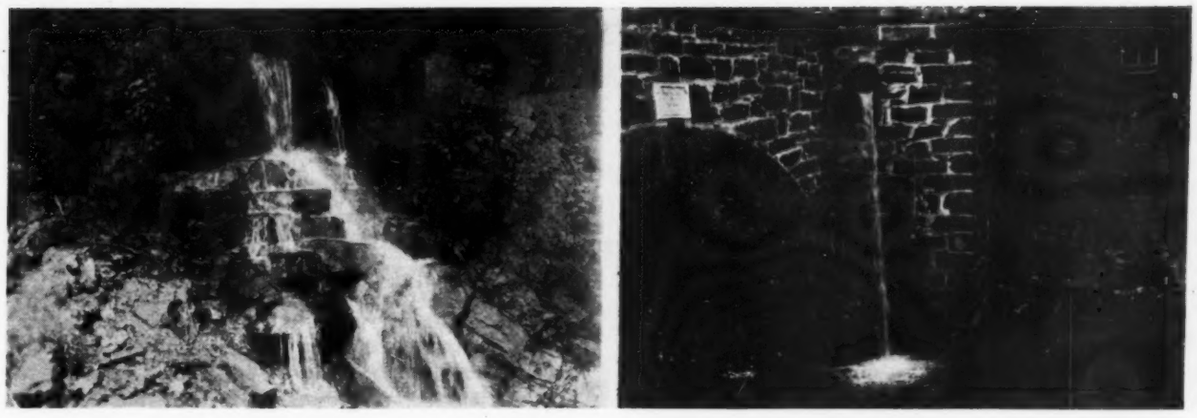
We scouted around until we found the following material, an old boiler, a piece of shafting and some iron flats. With a cutting torch, we cut out the tubes and the two ends of the boiler. We also cut off the heads of all the rivets and spot welded the same.

We then set a small platform out in the warehouse yard and cut a hole in the center for the shaft. There was a hole in the ground, under the platform so that the shaft would, when the roller was finished, project just one foot. We then centered the boiler around the hole in the platform, placed the shaft inside, centered it on top and filled the boiler with concrete. Plenty of scrap iron and stones were placed inside.



We let the boiler stand for a couple of days, then hauled it over to the warehouse shop. Our blacksmith then finished the job as shown in the sketch. An old cutting edge from a road patrol was bolted on and serves as a scraper in case dirt sticks to the roller.

Hauled with a light tractor, we have found this roller very useful in building tennis courts, compacting fills for sidewalks and the like.



Looks deceive: The view at the left seems innocent, but it shows an industrial waste even more deadly than the familiar discharge illustrated at the right.

Needed: A National Policy on Stream Pollution

IN THE light of present-day knowledge of sewage treatment, small excuse exists for a continuation of our lack of policy regarding stream pollution. Municipalities and industries, alike, are offenders in this regard. Among the reasons tending to perpetuate and intensify the intolerable conditions of many of our streams are the following:

1. The "let George do it" policy which is naturally adopted by many municipalities. Any municipal government hesitates to be the first to take the steps necessary for discontinuing its pollution of a stream, while other cities or industries, possibly in another state, continue to contribute enough pollution to make the same stream unfit for use.

2. The matter of cost, which is often a serious one to both municipalities and industries.

3. The fact that present efforts are limited by state boundaries with very few exceptions. If one state lays burden upon an industry, that industry promptly moves to another state, throwing many out of employment, depreciating property values, and reducing tax income.

As a solution to the problem, we suggest a *national* policy on elimination of stream pollution, fostered and directed by a national law laying down a program for a 5- or 10-year period. A law of this kind, being nationwide, would bear equally on all industry and on all municipalities.

Such a program, carried through in a reasonable way, would create a tremendous amount of employment, both through the labor directly employed on the construction work, and also indirectly because of the equipment and manufactured materials that would be used and of the fact that sewage and waste treatment today is largely mechanical, and therefore the employees of heavy industry would benefit.

Late developments in sewage treatment have greatly cut the cost of plant construction, and developments and improvements, tending to reduce still further construction and operation costs, are now in sight and need but small encouragement. With government financing, resulting in low interest rates, and with initial construction costs far below those considered necessary a few years ago, the burden of sewage treatment would be a light one in most cases. Development of trade waste treatment methods has lagged because there has been small demand for such installations in recent years, except in a very few states. But for most wastes a suitable degree of treatment is possible at a reasonable cost.

Losses under such a governmental financing policy should be small. There are no better credit risks than our American municipalities, the record of a few of the larger ones notwithstanding. In industry, the risk might be greater, yet few industries which could justify their existence otherwise, would be unable, with moderate government assistance, to carry on needed treatment plant construction.

Some fifteen years ago the state of North Carolina enacted a law that every house within the state must have sanitary toilet facilities. That resulted in tremendous expenditures for that day and that locality, but typhoid fever and allied diseases have almost disappeared from the state and that forward step has proven

Dead fish bear mute testimony to polluted streams.

the best investment ever made in any state, so far as health, prosperity and general welfare of the inhabitants are concerned.

Today the nation is spending millions of dollars in conserving its national assets in the form of parks and forests. The investment necessary for returning the waters of many of our streams to their pristine condition of purity and charm, and for making them safe would be no greater, we believe; spread out over a number of years the burden would be small compared to those being assumed these days as a matter of ordinary routine.

The results of a program such as is suggested would be: 1. Relief of unemployment through the construction of such work, both directly and indirectly. 2. Greatly improved health conditions. 3. A gain in national wealth through the preservation of national assets, including fishing and aquatic recreation, and the charm of unpolluted water courses. 4. Reduction in cost of purifying surface water supplies for both municipalities and industries.

From the engineering viewpoint, control of design and operational features, provision for adequate future operation, and the general carrying out of the program would be in the hands of the engineering departments of the state boards of health, under the general supervision and coordination of some governmental agency, preferably the Public Health Service, which now has a small corps of very able engineers familiar with this problem; both of which would need to increase their engineering staffs for this purpose.

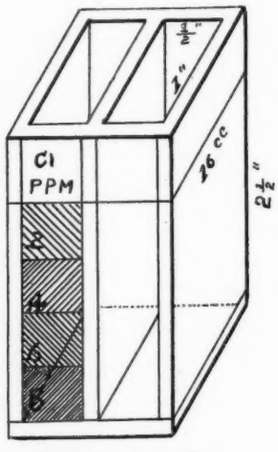
The need is nation-wide; many of the problems cannot be solved by the action of one state alone; and the formulation and carrying out of a national policy seem to offer the only prospect of saving our streams from intolerable pollution.

A Simple Chlorine Testing Outfit

By Francis E. Daniels

**Major, Sn-Res, U. S. A., Penn. Dept. Health, Harrisburg, Pa.*

THE writer has recently designed and constructed a simple, small, light, unbreakable outfit easily carried by the Army Medical Officer or trained Medical enlisted man, for determining the amount of hypochlorite to be added to water in the field, and to test the water after chlorination to ascertain if the correct amount of chlorine has been applied. Inasmuch as the outfit, with certain modifications perhaps, may be of considerable use in civil life, a description may be of interest to those who might prefer such a device, as the colors at shallow depths are more easily read than at 300 mm.



Chlorine testing box

The outfit consists of: 1. One upright rectangular box with a partition forming two compartments or cells ½" x 1" x 2⅜", inside dimensions, side by side, top end open. The box is made of nonbreakable transparent material, e.g., clear, transparent, colorless pyralin. A line is drawn on the right hand cell at the 16 cc volume. On the face of the left hand cell from the 16 cc line down, are four bands of permanent yellow color to match accurately the color developed in the water in the right hand cell by orthotolidin and .2, .4, .6 and .8 ppm. chlorine respectively.

2. One dropping pipette made of the same material as the box, about 5/16" diameter, 3½" long with ⅛" bore.

3. A supply of standard orthotolidin testing solution, put up in doses of .3 cc each in individual wax capsules.

4. The three items are assembled in a compact carrying case. The total weight of the outfit is but a few ounces and to save space the testing box is filled with capsules when carried in the case.

To Determine Dose to Be Applied

1. Mix the hypochlorite solution in accordance with the usual instructions given.

2. Fill the testing box to the 16 cc line with the water to be chlorinated and add a dose of orthotolidin to the right hand compartment by squeezing into it the contents of a wax capsule.

3. With the dropping pipette add the hypochlorite solution carefully, a drop at a time, until a color has developed to match the proper color at the left. For every drop of the hypochlorite solution so used, 16 cc of the same solution will be required for every gallon of the water to be chlorinated.

The testing box should not be used for measuring the hypochlorite solution, but it may be used to measure clean water into another cup or vessel to calibrate it for dipping the hypochlorite solution; e.g., a cup holding 36 of the 16 cc amounts may be used to chlorinate a Lyster bag of 36 gallons by adding as many cupfuls of the solution to the bag as the number of drops used to produce the required color in the test box.

NOTE: 16 cc were decided upon because these pipettes drop large drops. If a standard drop of 1/20 cc were used only 14 cc would have been needed.

To Test the Chlorinated Water

1. Fill the box with the water to the line.

2. Squeeze contents of an orthotolidin capsule into the right hand compartment, mix and compare the color developed, with the color bands.

To those who use orthotolidin for testing for chlorine we would like to repeat a caution which has often been noted in the literature, but may at times be forgotten. A red color upon the addition of the orthotolidin is not always due to excessive dose of chlorine but may be due to insufficient orthotolidin. If the red is due to concentration the red will fade into yellow upon dilution. If due to insufficient orthotolidin the color will remain red upon dilution; but will immediately turn to yellow upon the addition of more orthotolidin.

Screens for Treating Cannery Wastes

By L. F. Warrick

AT THE present time in Wisconsin the problems offered by pea canning wastes are being taken care of by the installation at the canneries of screening facilities and fill-and-draw types of chemical treatment units. The treatment afforded by these installations has satisfactorily overcome difficulties previously experienced at sewage disposal plants receiving the wastes.

The results of experimental work in the treatment of cannery wastes in Wisconsin demonstrate that:

1. For the removal of gross solids, mechanical screen units covered with 40-mesh wire are found to be most satisfactory and constitute a very essential part of any treatment system. Every canning factory should be equipped with effective waste-screening facilities.

2. For further treatment of the screened waste to reduce objectionable organic matter 50 to 75 per cent as measured by the oxygen demand, it is necessary to apply 3¼ pounds of ferrous sulphate and 7¼ pounds of lime per thousand gallons of pea or carrot canning wastes; 2¼ pounds of ferrous sulphate and 6 pounds of lime per thousand gallons of wax bean wastes; 3¼ pounds of ferrous sulphate and 6 pounds of lime per thousand gallons of corn wastes; and 4½ pounds of ferrous sulphate and 14 pounds of lime per thousand gallons of beet wastes. Thorough mixing of the chemicals with the waste and a settling period of at least one hour are required to insure proper treatment. Mixing previously precipitated sludge with fresh wastes retards the settling rate. Daily removal of the sludge is essential.

3. A trickling filter constructed of crushed limestone 8 feet in depth will reduce the oxygen demand of pea canning waste remaining after chemical treatment 35 to 84 per cent if the volume of wastes applied does not exceed three million gallons per acre of filter area per day. About two weeks of operation were required before the filter became effective.

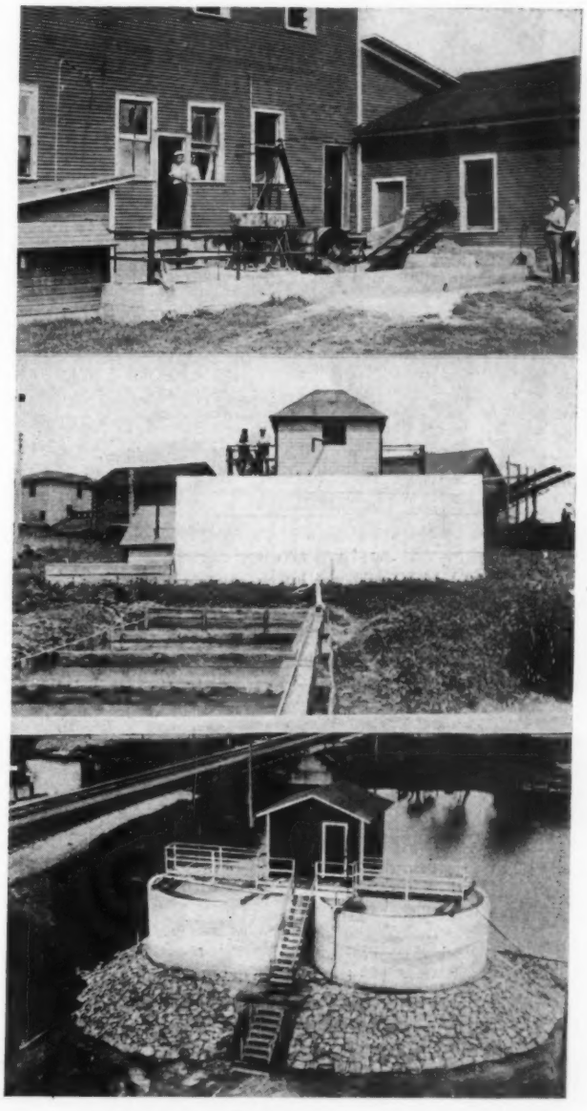
4. Operation costs of chemical treatment plants have varied from about one-third to three-fourths of a cent per can of No. 2 cans of peas. The cost of a treatment plant properly designed, constructed and equipped for the treatment of wastes from a three-line pea canner was $3,500.

5. Sludge produced by proper chemical treatment dries rapidly on sand beds and has no appreciable odor. It has a fertilizer value of about $3.50 per ton, sufficient to warrant its removal and use on nearby farms.

6. Disposal of the factory wastes by broad irrigation was not found satisfactory for general application. It may be possible in exceptional cases, to dispose of the wastes by this method on exceedingly porous soil, and at isolated sites where odor control is not essential. Control of odors by chlorination, with this method of disposal, is limited in effectiveness.

In the case of pea canning wastes the volume of the wastes is large and the period of operation of the factory is usually in the neighborhood of six weeks. If small municipalities were to attempt to provide satisfactory treatment for pea canning wastes, it would be necessary for them to double if not triple the capacity of their plants in order to take care of this waste, which is discharged for only a period of six weeks. This would mean a considerable investment for a municipality in order to take care of the wastes from one factory. On the other hand, the type of treatment required to treat this type of waste would not be entirely satisfactory for the treatment of domestic sewage.

The above is an extract from article by M. Warrick, who is State Sanitary Engineer of Wisconsin, in the State Board of Health Bulletin.



TOP—*Initial step in cannery waste treatment. A 40-mesh rotary screen unit with conveyor for removal of screenings. A dry feeder for lime and pump sump are shown in foreground.*
MIDDLE—*Chemical precipitation plant for cannery wastes using fill and draw process. Lime and ferrous sulphate are mixed with wastes by paddles on vertical shaft in center of tank. Sludge drying beds in foreground.*
BOTTOM—*Similar process using round tanks with conical bottoms. Silo forms may be used in constructing such tanks. Steel tanks have recently been installed at several canneries.*

How and What Is a Smooth Pavement?

By Bernard E. Gray

IN a recent conversation with the chief engineer of one of our large cities, he remarked half seriously: "We are about thirty years behind the times in some of our technique of street construction." Without in the least reflecting upon the ability of these large engineering organizations, it is a fact that there is greater resistance to change and possible improvement of method (due to the number of men who must pass upon the matter), than is the case in smaller cities where only one or two engineers need to be convinced before a particular procedure may be modified. Also, because of the larger volume of work under way in a metropolis, investment in contractors' equipment and employment of large personnel both tend to continue old methods for some time after new procedure has been quite generally adopted elsewhere. Possibly a third reason is in the congested traffic conditions which prevail in large cities, and the unwillingness to experiment at the risk of delaying work, the authorities preferring to wait until such experimenting has been concluded by others who do not have equally difficult conditions.

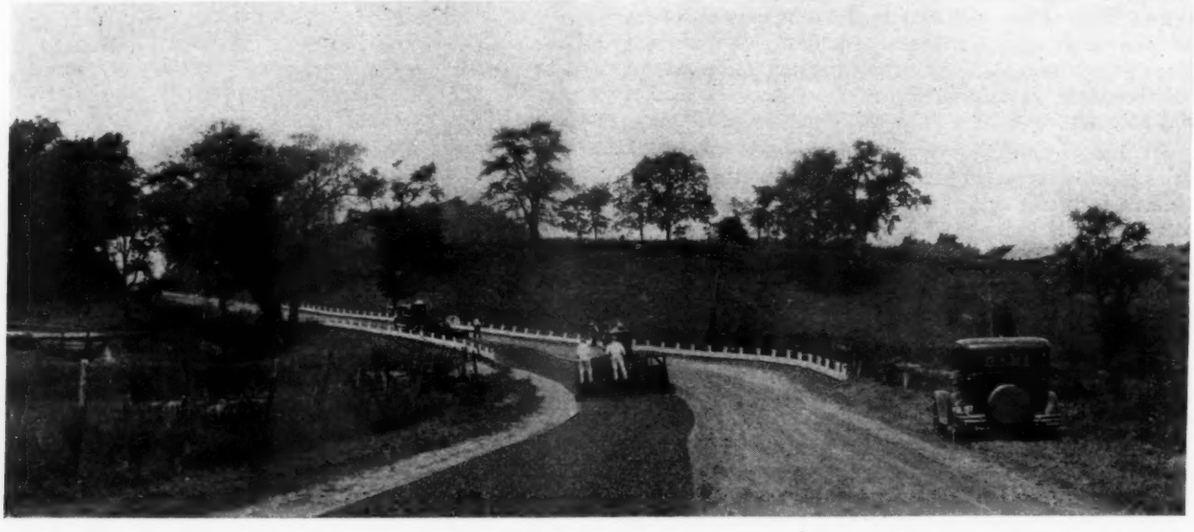
A case in point is the use of some of the newer equipment for spreading and finishing bituminous pavements, with view to achieving smoother surfaces. The question is sometimes asked: "How smooth is smooth?"—and the answer is—"As near like a billiard table as possible." The public wishes to ride in such comfort as will permit reading while riding, and this means much higher standards than those formerly acceptable, particularly now that bus traffic is fast replacing the old surface trolley car.

It is axiomatic that the more nearly uniform are all the operations of placing a pavement, the more perfect will be the finished surface. It is also apparent that wherever the effect of the human equation can be eliminated or minimized, there are less likely to be variations in the final results. No pavement can be placed and finished by hand that will be equal to one constructed by mechanical means, either in smoothness or in durability.

It is realized that at the moment advocating greater use of equipment is a somewhat unpopular stand to take, but it is about time that the American people pulled themselves out of the "slough of despond" and began to go forward once more. All past progress has been accomplished by using more machinery, not less; and it is a further certainty that re-employment will be increased, and not lessened, when the heavy industries, such as equipment plants, are working once again on full time. Therefore, not only will improved pavements be obtained when constructed by mechanical means, but there will be a greater employment of labor as well.

For five years or more, mechanical finishing has been standard practice in California wherever hot-mix asphaltic concrete was placed on state highways, and recently this has been adopted in the midwestern states. The excellence of the finished surfaces, as compared with hand raked pavements, is so marked that there is no comparison. Several of the eastern states also have changed their requirements; for example in New York, which is placing some exceptionally fine surfaces, it is required that for all contracts involving over 5,000 square yards a mechanical spreader and finisher shall be used.

All of the early finishers operated on side forms, and this type is very efficient, particularly in new construction. A later type operates on crawlers or runners with a long wheel base, both in connection with a portable mixing plant and without. Various widths up to thirty feet are available. Cities have used such types occasionally for park and boulevard work, but have been slow to adopt them for routine street construction. Recently another type has come on the market, which



Right half of road finished the day before and carrying traffic. Left side being mixed and ready for rolling. This type of spreader carried on 21-foot skids.

is for use with all types of bituminous mixes both hot and cold. It is self propelled, and handles almost like an automobile so as to be readily turned within a small area.

A desirable feature is the hopper into which the asphalt mixture is placed, there being revolving blades within, and at the bottom a cutter bar, so that any lumps are thoroughly broken and a layer of uniform density is spread. The writer observed no less than eight such machines at work on municipal construction in Indiana this summer.

After spreading a bituminous mixture, it is necessary to so compress it that traffic will not affect the surface afterward, or at least if it does so the change will be uniform without detriment to the riding qualities. Much rolling is done in a haphazard manner, and a good operator is a man who is just as much an artist in his field as any other expert. Recent studies in this work have modified some of the old notions materially, and the design of mixtures themselves will undoubtedly be changed as a result. For further reference on this subject the reader is urged to read the April, 1934, issue of *Public Roads* printed by the United States Bureau of Public Roads, which deals quite extensively with this subject. Rolling should follow almost immediately after spreading, especially with hot mixes, when the mixture is in a readily plastic state and can be compressed most readily. A three-wheel roller is distinctly superior for the initial rolling and will produce the greatest possible density of pavement.

A recent development in roller equipment is the addition of a small diameter roll which is hydraulically operated, and which may be raised and lowered as desired. By lowering this roll until in the same plane as the large diameter rolls, any high area in the pavement under it will raise the large front roll off the surface, thus bringing extra weight on the small roll and consequently "evening out the bump." When all rolls are in contact, the surface is of necessity smooth to a close tolerance, by reason of the long wheel base of the roller.

An observation recently of such a roller operating outside of Springfield, Massachusetts, brought out a number of interesting points. The job was a resurfacing operation (asphaltic concrete over old Portland cement concrete), using a rather thin section. The mix itself was the Topeka type but with little or no 200 mesh content, in other words a fairly coarse open mix. The finished road will be forty feet in width, and the work is being accomplished under traffic.

One point is that the small roll should not be lowered at first, the initial or breakdown rolling being done with the ordinary large rolls. If the small roll is lowered at first it tends to shove the mix, due to its small diameter, and therefore serves no useful purpose. Therefore the initial compression is all done in the usual manner. It is then desirable to wait until the pavement partially cools to a temperature of about 175°F to 200°F (with a cold mix, until it partially sets). The small roll is then lowered until about one-quarter inch above the plane of the large rolls, and the roller passed once over, thus taking care of any extra high spots. It is then lowered to one-eighth inch and rolling repeated; and finally to the same plane, so that practically no variation of as much as one-eighth inch in ten feet remains. It is most interesting to note how the front roll leaves the surface and the tremendous pressure that comes on the small roll, as a high area is rolled out.

Top—Old concrete being resurfaced, work being carried on half-width at a time. Middle—Old p. c. concrete resurfaced with 2" of coarse graded asphaltic concrete. Edge marking with 6" white paint bands makes driving safer. Bottom—New type roller with central roll in contact.

Another point in thin section resurfacing work is there is no surplus material around it to be moved laterally, so one should not attempt the impossible when resurfacing very uneven old surfaces. Under such conditions all depressions over three-quarter inch depth in a length less than the roller wheel base, should be patched first and then either tamped or rolled. Then when the resurfacing course is placed, it will be uniform in depth, and rolling will be fully effective, as there will always be a sufficient excess of material to be moved laterally and produce a perfect surface.

Still a third point in connection with this type of roller is the possible elimination of all need for cross rolling. Observation was made of adjacent surfaces, one finished by the conventional method of longitudinal and diagonal rolling, and the other by the new method. The latter had a smoothness of surface in every way equal, and in some respects superior to that produced by the old method. There can be no question that the high pressure under the small diameter roll, when applied at the right time, is very effective in removing unevenness, and that no amount of rolling with

the ordinary roller could ever achieve such a result, as the bridging of the cooling mixture resists further compression. The application of 500 to 600 pounds pressure to high areas, and then subsequently to all the area produces the necessary lateral flow of material (even though slight), which results in a very dense even surface.

It is to be remembered that different size rollers are required for different conditions. One objection that may be raised immediately by some engineers is that the usual three-wheel roller cannot operate in certain narrow areas. This is true, and of course a roller of suitable dimension should be obtained. An interesting example of this condition was observed in Ohio last summer. The situation required the resurfacing to be carried on in ten-foot lanes, and with no opportunity for much overlapping beyond this lane. Attempting to use a roller of 92-inch overall width and two-foot width rear rolls, it was soon obvious that there was a strip nearly two feet wide down the center that was not touched by the rear rolls, even though to the casual observer it might appear rolled. It requires a roller of not over 72-inch overall width to completely roll a ten-foot lane without overlapping. In city work, where there are many service openings to be avoided, this narrow lane condition is found frequently, and is the reason why narrow-width tandem rollers often are preferred. However, the same principle of a moveable center roll is applicable for any conditions, so that the necessary pressure may be applied, and rollers of this type have been used in England for some time.

Marked improvements in the technique of placing and finishing all varieties of bituminous surfaces have been made in recent years, and engineers are more and more turning to the use of the necessary new equipment to accomplish superior results. No pavement except a truly smooth one should be permitted anywhere, now that the means for easy, economical surfacing are available. A state engineer recently said: "When I assumed office two years ago, there were a number of signs along our highway which read, 'Rough Road Ahead.' I called in the division engineers and together we made the necessary plans and carried them into execution, so that such signs are no longer necessary. I feel that signs of this character, or rough roads without signs, are a reflection upon my ability as an engineer." Well, I wonder! He might be right.

Industrial Wastes Interfere with Imhoff Tank Operation

An outstanding case of sewage treatment plant overloading by industrial wastes was found in a small city in Wisconsin. This municipality has a population tributary to the sewerage system of approximately 1,200 people, and the sewage is given partial treatment in an Imhoff tank prior to discharge into a creek affording limited dilution. A large creamery was connected to the system, discharging into the treatment plant a considerable volume of milk wastes, including some buttermilk and whey. Later a three-line pea canning plant started discharging 50,000 gallons per day of washings, 30,000 gallons per day of cooling water and the silage juice from about 800 acres of stacked vines, into the city sewers. Under normal conditions the Imhoff tank would furnish approximately 3½ hours detention period for the domestic sewage, but with the addition of the creamery wastes the detention period was reduced to about 2¾ hours. During the time when this tank was receiving both the wastes from the creamery and the canning plant, the detention period was only 28 minutes. It is almost needless to state that treatment efficiency tests gave negative results.

Considerable difficulty has been experienced with foaming in this Imhoff tank, and accordingly action was taken locally to build up the walls around the gas vents about 4 feet. At times these walls are found to be insufficient to prevent the overflow of foaming sludge. It was found impossible to remove much sludge from the digestion compartment of the tank in the ordinary manner, due to the fact that the bulk of the solids were to be found at the top of the tank in the gas vents. Since the foaming was experienced after the creamery was connected to the sewerage system and before the canning plant wastes were added, this type of operating difficulty can be attributed to excessive amounts of untreated creamery wastes.

That milk wastes are responsible for ineffective operation of municipal disposal plants was further demonstrated in a village which recently installed a sewerage system and treatment works. As in the foregoing case, treatment was in the form of an Imhoff tank. Only about 135 connections were made to the system, resulting in a small volume of domestic sewage to be handled by the plant. Wastes from a cheese factory with a milk intake of about 60,000 pounds daily after preliminary treatment in a septic tank, were allowed to discharge into the village sewers. As a result the per cent reduction of settleable solids was almost negligible.

Accordingly preliminary treatment for the cheese factory wastes, with the exception of whey, has been provided and has resulted in marked improvement in sewage disposal plant operation. This preliminary treatment is in the form of biological filtration for the vat, floor and utensil washings, the whey being returned to the cheese factory patrons for use on surrounding farms for stock feeding purposes. Consideration is now being given to the installation of drying equipment and the recovery of the solids in the whey in the manufacture of valuable food products. The pre-treatment of the washings is accomplished by a crushed granite filter, eight feet in depth, intermittently dosed by means of tipping troughs. The construction of this filter was based upon results obtained in experimental work conducted at De Forest, Wisconsin, during the period 1927-30, and information concerning similar work in Iowa, Ohio and Michigan.

The above information is from the Wisconsin State Board of Health Bulletin.

The Editor's Page

That Highway Conservation Corps

A number of highly interesting and generally very favorable comments have been received anent the proposed Highway Conservation Corps suggested in our December issue. In general, these point out that low-cost employment could be given some three hundred thousand men through this means; that in return for this work, if done under the direction of a competent engineer, the tax-payers would receive some direct benefits from the vast sums now being received, and that these benefits would be more immediate in nature than those derived from the present CCC. In fact, some of our correspondents have suggested that relatively heavy hauling over some present gravel and similar light-surface roads serving CCC camps have actually resulted in damaging these roads.

More comments will be welcomed. Copies of that section of the December issue which had to do with the Highway Conservation Corps and with the value of highway construction work for unemployment relief have been sent to practically all state legislators, so that they will have an opportunity to consider this matter. A considerable number of comments have also been received from our readers on the section mentioned above.

Indiana State Roads Earn 280% Profit Over Maintenance Costs

Figures collected during a traffic survey of Indiana's highways by the State Highway Commission, with the advice and assistance of the U. S. Bureau of Public Roads, have been published by that Bureau in the December issue of "Public Roads," together with an analysis of them, which shows some interesting results, one of which is the amount earned by the various roads on the basis of use by traffic. The surfaced roads of the state (of which there is a greater mileage than in any other state of the Union) total 59,085 miles, of which 8,423 miles are classed as State roads and 50,662 miles as county roads.

Assuming an estimated gasoline consumption by passenger cars of 15 miles per gallon and 11¼ miles per gallon by trucks, the net revenue for a year from the 4-cent gasoline tax on all rural roads was $10,656,867; and, calculating on the basis of the traffic survey, 66.5% of this was earned on State roads and 33.5% on county roads; or $7,081,766 and $3,575,101 respectively. Proportioned on the same traffic figures, registration fees on the rural roads totaled $3,821,306, of which $2,539,841 would be assigned to the State roads and $1,281,465 to the county roads.

The figures show that the sum of gas tax and license fees amounts to $1.40 annually for each daily vehicle-mile of travel on the average State road and $1.39 on the average county road. The maintenance charges on State roads averaged $411 a mile, while the average earnings per mile were $1,145.20; but on the county system, while the maintenance cost averaged $187 a mile, the average earnings were only $70.33.

Disposal of Garbage via the Sewers

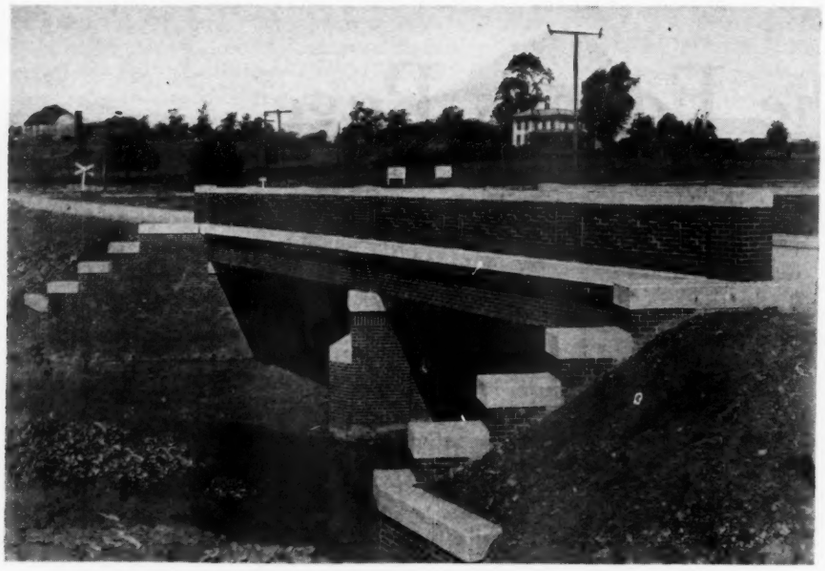
Four items in the two or three latest installments of the "Digestion Tank" indicate the international attention being paid to the idea of combining the collection and disposal of garbage and other refuse with that of sewage. For several years a few cities in this country have been experimenting with grinding, shredding or otherwise reducing garbage to small particles and discharging it into the sewers (as at manholes), and studies have been made of the effect of garbage in sewage on the operation of sedimentation and digestion tanks. But the idea referred to goes further and contemplates placing garbage, and in some cases ashes and other refuse, into the house connection, thus eliminating refuse collection as well as separate disposal of it.

The practice has already been tried on a small scale in France. In England, engineers are discussing it in a general way. In this country, methods are being developed for putting it into practice, including a mechanical grinder, operated by electric or hydraulic motor, which will reduce all kitchen refuse to a size sufficiently small to prevent clogging of the sewer (we suppose metals and other non-grindable matters will be removed, to be disposed of otherwise), the ground material to be washed into the sewer by water from the sink.

The practicability of this idea will depend, we believe, on that of the household part of it. If bacteria will not take kindly to the addition of garbage to their regular sewage diet, we can add them to the already unemployed, and utilize non-bacterial methods of treatment. As to transportation in the sewer, considerable fine garbage already finds its way there from the kitchen sinks and causes no trouble in the sewers. Adequate screens, of course, would prevent the entrance of spoons, unground chicken bones or other large matters. Some provision should be made against the entrance of too large a mass of garbage at one time or without sufficient water to float it; but this would not seem to be impossible of attainment with a minimum water consumption of 100 to 150 gallons per family per day. The practical difficulty that suggests itself to us is that of installing a kitchen device that will be fool-proof and not be put out of service by the dish rags, broken crockery, wooden skewers and other miscellaneous matters that the kitchen workers may wish to get rid of.

As to disposing of screened ashes in this way, as proposed in England, that may be asking too much of the water carriage, in this country, at least—in England the average house does not create a quarter as many ashes as do those in this country.

At any rate, the idea is an interesting one and we hope to see it tried out in a small way before long.



Reinforced brick masonry used in bridge construction.

New Type of Highway Bridge

Involving the Use of Reinforced Brick Masonry

By J. R. Burkey

Chief Engineer of Bridges, Ohio Department of Highways

THE accompanying photograph shows a new type of highway bridge which was recently completed by the State Highway Department of Ohio.

Located in the midst of the clay manufacturing district of Ohio, and with two brick plants within a half mile of the structure, a bridge of this type was selected as fitting into the scheme of the National Recovery Act of which this project was a part.

The structure consists of two spans, each 32 feet clear and skewed 22 degrees from normal to the center line of the highway. There are two sidewalks or "refuge walks", three feet in width, as a safety measure for pedestrian traffic in this small community. The height of structure from bottom of footing to grade is approximately 20 feet.

The footings and decorative caps on the structure consist of reinforced concrete, but all other portions of the piers and abutments are built of reinforced brick masonry. One to three Portland cement mortar, to which was added 12 per cent (of the cement volume) of hydrated lime was used in the building of one of the abutments. The remainder of the brick masonry was built with 1:2½ mortar, using a commercial mortar cement. The latter mortar was the more workable and easy to handle, and although its crushing strength was somewhat lower than the Portland cement mortar, it was deemed quite ample to provide a reasonable factor of safety over the design stresses. The original design did not contemplate the use of two kinds of mortar, but during construction, the two types were adopted with the thought that we would gain some experience as to the performance of these materials in the same structure. The back of all abutment brick work was waterproofed with two coats of hot asphalt, using a total of about one gallon per square yard of surface.

In the design of the reinforced brick masonry, the following unit stresses were used: Compression—600 pounds per square inch; shear—20 pounds per square inch; bond for deformed bars—50 pounds per square inch; tensile stress in reinforcing steel—14,000 pounds per square inch; ratio of modulus of elasticity of steel to brick masonry—15.

The superstructure is of reinforced concrete of the conventional T-beam type, the outside being faced with brick supported on a shelf angle which has projecting anchors embedded in the concrete. Metal wall ties are also used between the brick work and concrete.

The railing is composed of reinforced brick masonry, capped with reinforced concrete as a trim and for the additional function of excluding water from the vertical joints.

The cost of the brick masonry was $13.65 per cubic yard exclusive of the steel reinforcing. The railing was a separate item of cost, the price of which was $4.00 per lineal foot, which included brick work, concrete cap and all reinforcing steel.

The reinforcing steel varied in size from ⅜" to ¾" round, according to the demands of the particular section, and was embedded in the mortar joints of the brick work.

The structure was built by the O'Connor-Kipf Company of Cleveland, and was opened to traffic in August of 1934. The total contract price of the structure, exclusive of piling (which was a supplementary item covered by an extra work contract), was $16,150. Work was done under the direction of O. W. Merrell, director of highways; H. P. Chapman, assistant director; J. R. Burkey, chief engineer of bridges; W. H. Rabe, chief designing engineer of bridges; J. C. Merrell, designing engineer, having immediate charge of the development of the details.

Portable Bridges for Emergency Use

Interruption of travel due to washout, collapse or repairing of highway bridges on Ohio State highways is minimized by the use of temporary bridges, which can be set up easily and quickly, and removed when the permanent bridge is ready. No nails or spikes are used, but all connections are made with bolts. A bridge can be erected for any length in multiples of 20 feet, designed to carry safely any load allowed by law to use the highways. Most of the State's highway divisions carry in stock sufficient material, fabricated and ready for erection, to build at least 120 feet. Several have already been used.

Refuse Collection in Seattle

Trucks dumping rubbish in Seattle

PRIOR to 1932, Seattle, Washington, had let its refuse collection to two groups of contractors and sub-contractors at prices which mounted to more than $900,000; but that year it let a contract for the entire collection for a period of five years at $364,278 a year, to the Cities Contracting Company, formed by George Nelson (well-known Seattle contractor), Ray S. Kelley and Frank Tierney (Butte contractors) and Arthur Banks.

The city has a population of almost 400,000, covers a number of hills, is more than 12 miles long north and south, while its width varies from seven miles at each end to two miles in the middle. To give satisfactory collection under these conditions at about 90 cts. per capita per year required careful planning and management, but the company has been able to make a small profit by the system it has developed for supervising its personnel and trucks and laying out the routes. Data on all operations are recorded and analyzed, permitting prompt recognition and remedying of any details of the service that show signs of being inefficient.

The company employs 125 men and uses fifty 1½-ton trucks equipped with 8-yard steel dump bodies operated by hand hoists; two ½-ton trucks, used mainly for general run-around work; and two 2-ton trucks, used mostly for transport of supplies; all being "Internationals." The 2-ton trucks were at first used for collecting in the business section, but later were replaced by 1½-ton because of the flexibility of the latter. In addition to the driver, each truck carries a helper (called a "swamper"), with two helpers on some routes. To house the trucks, the company has a two-story garage 120 by 110 feet, large enough to hold the entire fleet. In addition to the drivers and helpers, there is a dump man at each of the seven dumps, garage mechanics, and a night workman who regularly greases all trucks and washes 10 to 15 of them each night.

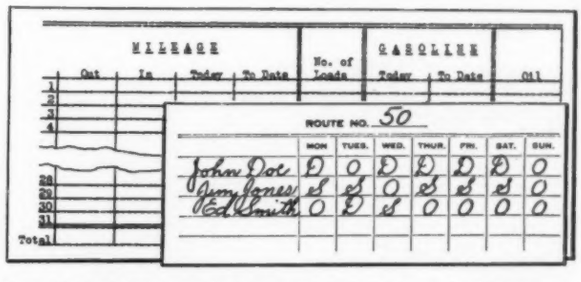
The seven dumps are located at low places in various parts of the city. They are built up to an average thickness of 12 ft., and on reaching this thickness are covered with about 18 inches of dirt. The trucks back up to the edge of the fill to dump, and to facilitate this, aprons made of planks are used; three aprons being used at the larger dumps so that three trucks may dump at one time to avoid delays.

The average daily mileage for each truck is about 30 miles, collecting an average of 3.61 loads a day and traveling an average distance of 8.18 miles per load. Collections are made once a week in the residence districts, every other day from apartment houses, and every day in the business section.

The upkeep cost of the 54 motor trucks for the year 1933, including labor and material, was $2,051.72 or less than $40 per truck. The cost for August, 1934, reached a low of $498.72. These low costs are made possible by continually impressing upon the drivers the necessity of careful truck operation, and by daily check of mechanical troubles by trained garage mechanics.

An important feature of the organization is the dispatcher's office, maintained in the garage. Close check of every truck at any time of any working day is greatly facilitated by a big dispatcher's book, which consists essentially of a key map showing the entire city divided into numbered districts, and of large-scale maps of every district with all streets shown in large size and named. Each detailed district map is divided into sections with different colors and on each section is painted the day of the week the truck for that district will call—Monday, Tuesday, Wednesday, etc. Thus, when a resident calls to find out when garbage will be collected, by a quick glance at the proper district map the dispatcher, with his knowledge of the route traveled by each truck, can tell within fifteen minutes or so when the collection will be made. For those sections in the business district where collections are made each day, special large-scale maps are provided. The work of the dispatcher is closely supervised by Messrs. Kelley and Tierney who are in charge of the oeprating part of the business.

Particular care is exerted by the dispatcher in making



Special individual record sheet, one for each truck. Below, employment card.

comprehensive records of all complaints, and for this purpose a special form, 4¼ by 3½ inches in size, has been devised (to be filled out in triplicate), on which are listed the more common complaints so that a given complaint may be recorded quickly by mere check marks; while at the bottom is a space on which the driver must make his report. Naturally, drivers don't like to have complaints sent in about their work, and the knowledge that every complaint is recorded in this way and requires a report from him instills in him and his helpers a desire to exercise care in their work at all times.

An interesting method has been devised for printing these forms. Two sets of three forms separated by perforations are printed on a sheet 13 by 8½ inches in size, the inside and outside forms being printed on the front side of the sheet and the middle form on the back. A blank space two inches wide at the left (without perforation for the left side of each inside form) is provided for binding several forms in a book. By folding the sheets along the vertical perforations, with the outside form on top of the middle form, and this in turn on top of the inside form and inserting pieces of carbon paper between them, the writing of the form in triplicate is greatly facilitated. The inner form stays in the book and serves as an office record. The other two forms being perforated are easily removed, and one is passed on to the driver, on which he must write his report and then pass on to the office, and the other is for the checker. The two outer forms of the top set on each sheet are also separated by perforations from the lower set.

Among the other forms used is one 7¼ by 4 inches in size entitled "Daily Truck Report," which is prepared and turned in daily by each driver. Each morning when the driver goes to work, he takes one of these forms and stamps on the back of it with time-clock stamp located in the garage the time he goes to work and also repeats this time-recording operation when he goes off duty. The bookkeeper checks each of these daily reports and transfers the information written thereon to the bookkeeper's time book. He also records on special sheets, of which there is one for each truck, the mileage (out, in, today, and to date), number of loads, gasoline consumption (today and to date), and oil consumption. Since the five-day, 8-hour-per-day, 40-hour-week plan has been adopted by the Cities Contracting Company, another form 5½ by 2¾ inches is utilized, one of which is made out for each route and shows how the men are employed for each week, D indicating driver; S, swamper; and O, days off. A special card has also been prepared for recording information on tires. One of these is filled in for each tire and contains data on when put on, when taken off, and all repairs.

Form No. 1

Route No..... Date.....

Address .....

Cross Street .....

Name ..... Phone.....

COMPLAINT

Missed All ..... Part.....

Do Not Replace Lids ..... Cans.....

Scatter Garbage .....

Crossing Lawn .....

New Service .....

Driver's Report .....

.....

Form No. 2

DAILY TRUCK REPORT

To be prepared and turned in daily by Drivers.

Route No. ..... Truck No. .....

Date .....

Number of loads hauled .....

Dumped at .....

.....

Speedometer reading IN .....

Speedometer reading OUT .....

Signatures .....

of .....

Helpers .....

Trouble reported .....

.....

.....

.....

Driver: .....

Check oil and tires regularly

Diesel Motors and Fuel Taxes

At the twentieth annual meeting of the American Association of State Highway Officials November 12th to 15th, at which 45 States were represented, a number of resolutions were adopted, among them one dealing with State taxes on Diesel fuels used in motor transport.

Modern inventions have caused a great development in construction of highways and in the building of equipment used on highways and in highway construction. The revenue of the States in connection with tax on gasoline applies also to other motor vehicle fuels, but in planning by State highway departments for the expenditure of funds over a two-year period it has been based almost entirely upon the revenue received on tax from gasoline. It has been demonstrated that Diesel-operated equipment and the use of similar heavy fuels affords this kind of equipment a greater mileage than gasoline fuel where the same amount of money is involved.

Many States are feeling the loss of revenue because of this condition. Diesel-operated equipment is making rapid advancement and thought must be given to maintaining the same amount of revenue as would accrue were all equipment operated by gasoline. The association recommends that the respective State highway departments cause a study to be made of this situation that an equitable State tax be placed on users of Diesel fuels in motor transport.

Patching with Tarnac C. P. in February

Cold-Weather Low-Cost Road Construction Using Tar

By A. R. Taylor
Tarmac Dept., Koppers Products Co.

WHEN constructing tar roads in the winter time, extra precaution should be taken in the method of construction, as well as in the selection of the grade of tar to be used. Tar roads have been built during all seasons of the year, but last year, due to the enormous number of unemployed, one of the largest programs of cold weather construction was undertaken. The unusual conditions that are encountered in cold weather naturally make the construction work more difficult and costly than is normally the case. At the same time, such work is justified under certain circumstances, and there are various phases and steps in tar low-cost road construction that may be carried on during cold weather.

Due to the freezing and thawing conditions that are encountered in the winter months, it is advantageous to do as much preparation and as little bituminous surfacing work as possible. Although some difficulty may be encountered, the grading, drainage, structures and surfacing of the base course with gravel or stone may be carried on satisfactorily. When the sub-grade is frozen at the time of placing the base course aggregate, it should not be surfaced with tar, as such a procedure in all probability will result in failures following the spring thaw, which may be difficult and extremely costly to properly repair; whereas a base course without surfacing may be repaired with little difficulty and surfaced with tar in the spring.

When the base course has been constructed previous to freezing weather, the tar surfacing may be applied successfully if certain precautions are taken in the construction, and the work carried forward only on the warmest days.

Surface Treatments

On surface treatment work, care should be taken to see that all loose aggregate and lumps of dirt are removed from the road surface, and that it is reasonably dry before the tar prime is applied. It is best to apply the prime coat around 9:00 or 10:00 o'clock in the morning, or when the sun has had sufficient time to warm the road surface slightly.

For the prime coat, a light grade of tar, such as Tarmac P, which has a specific viscosity of 8-13 at 40°C., should be used, and applied at a temperature of 125-150°F. The application temperature used is higher than that ordinarily recommended, so as to help the penetration of the tar into the road surface. If it is found that complete penetration has not taken place, the tar prime coat should be covered with 5-10 lbs. of stone chips or sand in order to prevent traffic from picking it up.

The second application should consist of heavier grades of tar, either a heavy grade of cold application tar applied at a temperature of 125-150°F. or a hot tar applied at a temperature of 200-225°F. The heavier grades of cold application tar are more easily handled in cold weather. Regardless of which grade of tar is selected, the cover material should be spread immediately after the application of tar, and rolled as quickly as possible.

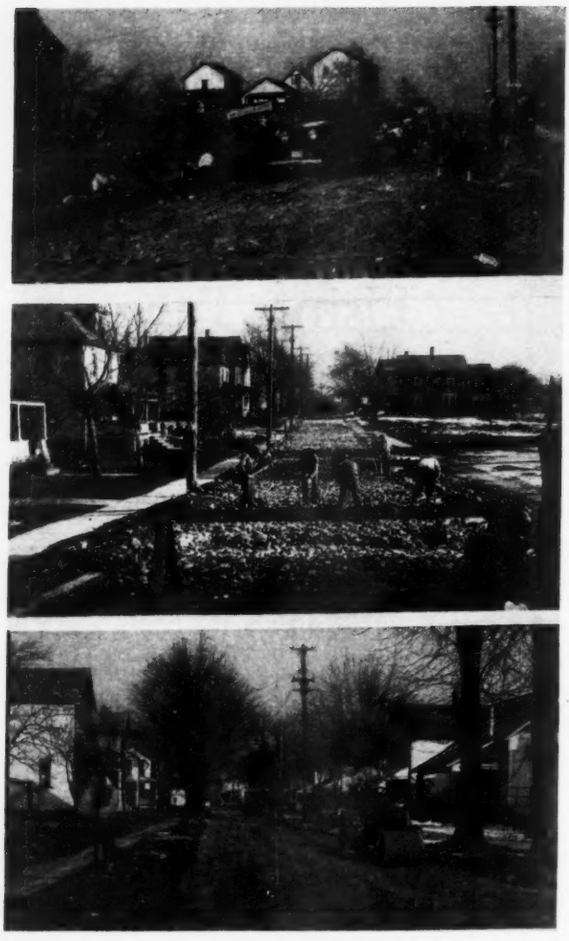
Mulch Treatments and Sand Mixes

The mulch treatment, consisting of aggregate ranging from 1¼" down to dust, should not be constructed in cold weather, except possibly in some of the extreme southern states, as difficulty will be experienced in balling up of the mix due to the presence of fines in the aggregate. The heaviest grade of tar that can be used successfully for this type of construction in cold weather is Tarmac P Grade 5, having a specific viscosity of 16-22 at 50°C.

The aggregate for sand mix work consists of very fine material, and the same comments apply to it as for mulch treatments.

Laying crushed stone base course in Pittsburgh, Pa., in January; CWA labor.

Finished penetration surface after sealing with Tarmac A in January; CWA labor.



Top—Grading a new street with CWA labor in February, 1934. Middle—Hand-knapping stone of base course in January. Bottom—Rolling knapped base after voids have been filled with sand, gravel and loam.

Mixed-In-Place Construction

The coarse aggregate type of mixed-in-place construction may be carried on in cold weather in those sections having reasonably mild winters. The tar used, however, should be considerably lighter than that ordinarily used and should not exceed a specific viscosity of 16-22 at 50°C. For this class of work the tar should be heated to a temperature of 125-150°F. and should not be applied until the sun has had a chance to warm the aggregate. The mixing operation should follow immediately and be completed the same day the tar is applied, so that the surface may be choked and rolled. This acts as a protection against inclement weather. The seal coat should not follow the mixing operation for a period of at least ten days, in order that the mix may have a reasonable time to set up. If the seal coat follows the mixing operation too quickly, it prevents proper curing of the mix and may result in rutting of the surface on the first reasonably warm day.

Penetration Construction

The regular grade of tar binder may be used for penetration work, but should be heated to a temperature of 250-275° F. and not applied unless the aggregate is dry. If the aggregate is wet, a blade grader may be used to move it from one side of the road to the other in order to help dry it. The choke stone should be spread and the surface rolled immediately following the application of tar. It is best to roll the surface with a heavy roller, and if possible to have one or more extra rollers on the job in order to obtain the maximum amount of compaction from rolling. In cold weather the hot tar naturally sets up very quickly, so if maximum compaction is to be obtained, it is necessary to roll quickly after the application of tar and the spreading of the choke stone.

The seal coat should follow closely the construction of the penetration course, and for this purpose a better seal is obtained by using a hot surface treatment tar, such as Tarmac A having a float test of 60-150 seconds at 32°C.

Retreatments

Retreatments are often advisable when a road shows signs of breaking up during the winter, as oftentimes a light retreatment will overcome the trouble and eliminate the necessity of expensive patching work in the spring. Under such conditions a light prime coat tar may be applied at the rate of .2 to .25 gallon per square yard and covered lightly with 5-10 lbs. of sand or other small sized, locally available material. In some cases the cover material may be eliminated entirely.

As a rule, cold application tars are better adapted for retreatment work in cold weather than are hot tars, because they are easier to handle and get a better bond with the old surface. Again, the cold application tar should be heated to 125-150°F. and applied only when the surface of the road is reasonably dry. As with all classes of tar work, the cover material should be spread and rolled immediately following the application of tar.

Patching

Patching work may be carried on with either Tarmac Cold Patch or Hot Patch. In the case of cold patch, the mix can be made up during bad weather, provided the mixing can be done in some covered place where the uncoated aggregate may have been stored to keep it dry. A better cold-weather mix will be obtained by heating the tar to a temperature of not over 100°F., or still better, by warming the stone. The latter may be done by dumping the stone over a metal pipe in which a small fire is kept, or by spreading the aggregate over metal plates under which are kept small fires.

During cold weather the penetration method of patching may be used, provided the Tarmac CP is heated to a temperature of not over 100°F. The penetration method should also be used for any hot tar patches, heating the tar to a temperature of 250-275°F.

Conclusions

Tar may be used for winter construction but it should be kept in mind that ordinarily better results can be obtained by doing the construction work during the warmer seasons. However, where conditions make winter work desirable, the following precautions should be taken:

1. Lighter grades of tar than ordinarily recommended should be used for the various types of construction.
2. The tar should be heated to the maximum temperature permitted.
3. The road should be reasonably dry before the tar is applied. The drying of the aggregate may be expedited by means of blade graders.
4. The tar should not be applied until the middle of the morning, when the sun has had a chance to warm the road surface as much as possible.
5. All mixing operations should be completed and rolled the day the tar is applied.
6. The choke and cover material should be spread and rolled immediately following the application of tar.

Engineering in Chemical Treatment of Sewage

By George L. Robinson, *Sanitary Engineer, and* Courtland F. Carrier, *Chemical Engineer*

FASHION seems hardly a word to use in presenting an engineering topic, but the marked cycles, or periods, in most fields of technical development suggest that even engineers may follow a prevalent mode; and in so doing they are apt to overlook solutions which, though antedating that mode, may be more suitable for many of the problems presented.

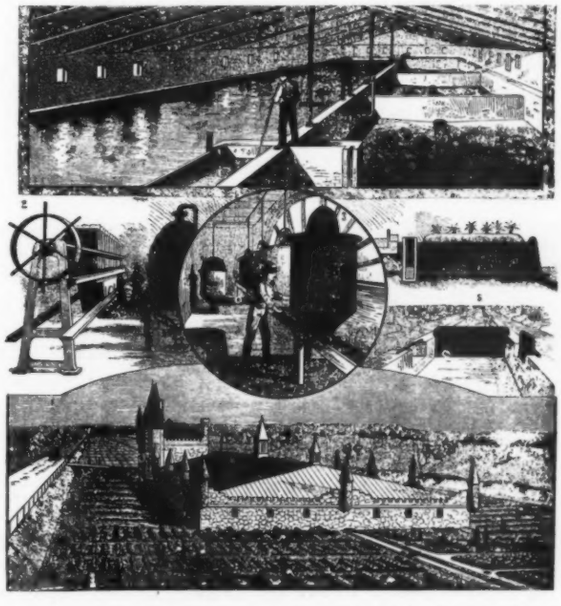
The history of sewage disposal is that of a succession of modes, each for the time being accepted in both Europe and America as a panacea, to be employed wherever the conditions could possibly be adjusted to permit it. This general acceptance of succeeding modes has latterly been stimulated by commercialization, the presentation by some prominent sanitarian of a new basic idea being followed at once by the patenting, by less original minds, of methods or devices for utilizing the idea and the natural and legitimate efforts to popularize the use of these patents. This may even direct technical progress along other than sound engineering lines, or retard its development towards real improvement.

Simple dilution, broad irrigation, and tank treatment—sedimentation—were the successive early steps in sewage disposal. Assistance of sedimentation by chemical treatment—precipitation—marked the introduction into sewage disposal of patented ideas and propaganda by those technically or commercially interested. From 1880 to 1890 most English sewage plants and some in the United States used chemical treatment, lime being the cheapest and most common agent employed, and hundreds of patents for chemical treatment were taken out. But the results were far from satisfactory, because of inadequate knowledge of the scientific principles involved and of control methods; colloidal chemistry and hydrogen ion concentration were not available nor had chemical engineering yet evolved adequate equipment.

Meantime, interest had arisen in the biological aspects of sewage and scientists in Europe and America were studying procedures aimed at a stimulation of nature's methods of rendering sewage matters innocuous. Enthusiasts predicted ideal results without the cost of chemicals; and chemical precipitation quickly became outmoded, while various phases of biological treatment were presented in succession, each in turn endorsed by scientists and pseudo-scientists almost universally for its few years of popularity. Intermittent filtration and contact beds for oxidizing sewage were followed by the septic tank employing anaerobic treatment for complete destruction of sludge. This failed to come up to prophesies and anticipations, and was succeeded by two-story tanks—the Imhoff tank being for several years almost the only othodox system in American practice, as the septic tank had been before it. Anaerobic digestion has gone through the usual cycle of enthusiastic reception, rapid development and crop of troubles, and a few years ago aerobic digestion, as embodied in the "activated sludge" treatment, became the new fetish to lead the sanitary world out of darkness and trouble. Unfortunately, variations in concentration, volume, quality and spasmodic injections of industrial waste are not conducive to meeting the whims of temperamental bacteria.

The field of biologic activity now seems to have been tilled close to the point of exhaustion and sanitary engineers are awakening to the fact that chemistry, both theoretical and applied, has travelled a long way since the end of the late century. The chemical field has lain fallow for a generation. New chemical processes are being tried out, involving modern details, which give great promise of meeting some of the most difficult situations. Most of them involve the use of basic ideas or agents of established reputation; therefore engineers are in a position to pass on the real merits of these proposals and need not depend on the "ballyhoo" of salesmanship.

Chemical treatment is strongest at some of the very points where the older processes are weakest. Biologic processes lack flexibility and positive means of control, while in chemical installations the dosage is readily varied to meet fluctuating demand, and reserve capacity can be put into prompt service at full efficiency. The dosage can be adapted to kind and quantity of trade wastes, readily handling many such materials that would seriously disturb a biologic plant. Odor control is more effective, partly due to the chemicals themselves, but also due to the much shorter retention time from raw inlet to effluent outlet. Chemical sludge is also more readily handled than biologic residuum. Improved chemical engineering equipment has opened the way for great potential economies in construction and operating costs. Chemical processes appear to be able to solve some difficult situations where other methods have failed, or may serve as sulpplementary capacity for handling peaks. No reason is seen why intelligent use of available engineering experience cannot develop a chemical plant of reasonable size that can be operated in congested districts, free from nuisance, and prac-



The first chemical treatment plant in the United States: East Orange, N. J., 1888. (See Public Works for February, 1931.)

tical to operate. Compact plants, operating at convenient points on fresh sewage, might even be located under docks or streets in large cities, thus saving millions on connecting sewers.

It has been raised as an objection that chemical treatment requires too much expert supervision, but we believe this is no greater than the requirements for successful operation of an activated sludge plant.

The trend and scope of this "chemical invasion" should be under sound engineering control and not left to popular enthusiasm for new ideas. It behooves engineers to become well informed immediately on the possibilities of chemical treatment for new installations, modification of existing plants to improve results, or to provide extra capacity.

Underlying Principles of Chemical Treatment

The various processes of chemical treatment have been frequently described and need not be repeated in detail but the underlying principles are all similar in purpose and will bear consideration from the engineering aspect. The equipment is a purely engineering problem but one which cannot readily be handled without a somewhat comprehensive understanding of the chemistry involved.

The elementary nature of many of the reactions is apt to lead to a mistaken sense of simplicity. The formation of a chemical precipitate to enmesh suspended matter mechanically is certainly not highly complicated, and if that were all that chemical treatment could accomplish, the process would be of little interest. Physical chemistry is not simple and the mere formation of the precipitate is the smallest part. There are three important elements vital to the satisfactory operation of chemical treatment which were not understood fifty years ago which come under physical chemistry:

(1) Adsorption of impurities on the large area presented by the surface of the precipitated particles.

(2) Coagulation of colloidal matter by neutralization of the electric charges.

(3) Alteration and control of the hydrogen ion concentration as expressed by the so called pH number.

Adsorption is probably of an electrical nature depending on the nature and intensity of the charge, and also a function of temperature and pressure. It is however specific i.e. the amount of one substance adsorbed on the surface of another is dependent upon individual properties of the substances as well as upon the general laws of adsorption. Therefore, to remove an impurity by adsorption it is necessary to select a precipitate which will adsorb the same as well as establish conditions under which it will do so with maximum efficiency.

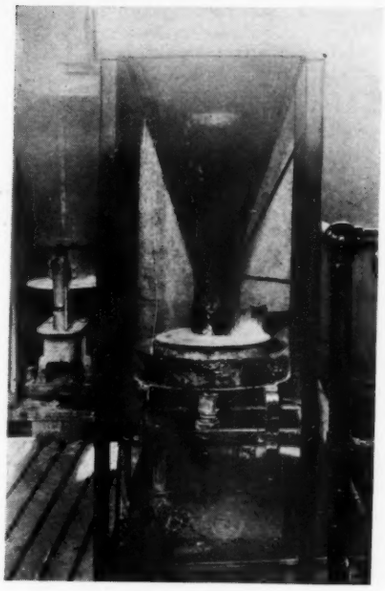
Coagulation. It has long been known that certain chemicals like lime, alum or iron salts would coagulate organic matter which was so finely dispersed that it could not be separated by sedimentation or filtration. This is the so-called colloidal state, a condition which is also a matter of electrical charges. These particles are so small that they are measured in terms of micromicrons, or trillionth parts of a meter. Some particles bear negative and some positive charges, and it was further observed that when particles of opposite charge were added to a colloidal solution, the electrical charges neutralized and the colloid was coagulated, forming vastly larger particles which would settle out or filter. The organic matter in sewage usually carries negative charges. Iron salts will form particles with positive charges, therefore it is explained why iron is an effective coagulant, its use having preceeded the theory by many years.

Ionization is an electrical effect which takes place when substances dissolve in water. It is governed by the state of dilution as well as by the nature of the substance itself. Solutions of substances in water contain free hydrogen ions and the number per cubic centimeter is called the hydrogen ion concentration. This varies with the relative degree of acidity or alkalinity. The modern unit of measurement of this hydrogen ion concentration is known as the pH number. Technically this is the logarithm of the reciprocal of the free hydrogen ion concentration. For water, the value is 7 and this is taken as the neutral point on the scale. Any number below 7 is acid and higher than 7 indicates alkalinity. Since these numbers are a logarithmic function, an acid of pH 1 is ten times as acid as one having pH of 2. The pH number is influenced by temperature and concentration, and is also specific for different substances. It is the measure of potential acidity and alkalinity rather than of quantity; therefore, to calculate the quantity of a given agent required to give a certain pH number it is necessary to know the quantity in the original solution as well as its pH number. The use of this scale is not so highly difficult and technical as it sounds. A workman can use a thermometer without knowing what the degrees mean. In the same way he can be taught to use an instrument for measuring pH and apply the readings without having any technical understanding of what the unit means.

A comprehensive understanding of these underlying principles of rather complicated physical chemistry is essential in weighing the merits of any proposed chemical treatment. The practical application also involves various unit processes such as sedimentation, filtration, drying and other chemical engineering features, as well as some chemical knowledge. It is quite obvious that the layout of a sewage treating plant is primarily the task for a sanitary engineer but this can probably be done more effectively with the collaboration of an experienced chemical engineer.

We believe that, where thorough investigation shows the necessity or advantage, chemical treating plants can be constructed more economically, will require less area and can be more positively operated under varying conditions than any other type of disposal plant. The cost of operation is an engineering problem to be worked out for each individual case. Essentially only screening devices, chemical tanks, settling tanks and sludge disposal equipment are required, but the selection of the process type adapted to the situation, the design of the plant and the specification of the operating conditions can be accomplished efficiently only under the supervision of experienced engineers.

There is not apt to be any new process so good that it will displace older processes for all conditions. Some of the older processes may be amply efficient and more economical under some conditions, and in other cases chemicals will make their best showing in modifying or augmenting an existing method. There are undoubtedly proprietary processes of merit, but these should be installed on the recommendation of neutral engineers and not by high powered sales methods. In any case, it is an engineer's job and is not to be settled by dictate of the prevailing fashion.



Nuchar dry feed machine

Up-to-date Carbon Control of Tastes and Odors

A brief summary of practices in applying activated carbon under various conditions, as developed by the latest procedures and experiences.

By F. E. Stuart
Research Engineer, Water Purification Div., Industrial Chemical Sales Co.

CARBON is applied to water either by dry feed equipment provided with a water ejector; or by solution feed apparatus, or mixed with alum or lime. Being insoluble, it does not interfere with routine control methods. In a filter plant consisting of mixing chamber, settling basins and filters, the carbon can be applied to the water as it enters the mixing chamber. During the first week of carbon treatment it is advisable to apply a duplicate dose to the water flowing onto the filters. This can be done by splitting the feed of the dry-feed machine and applying half to the mixing chamber and the other half to the outlet of the settling basin.

If dry-feed equipment is not available, the most convenient method is to mix the carbon with the alum for pretreatment and use a barrel for application to the settling basin effluent. Many operators keep for emergency use a barrel with a ½-inch gate valve and nipple, which can be placed at any point—to feed directly onto the filters, or half way through the basin, or in the mixing chamber to supplement the alum and carbon mixture.

When high dosages of carbon are necessitated by industrial spills or severe algae disturbances filter runs may be shortened, when the remedy is to "jolt" the filter, carrying the carbon particles down into the sand. In fact, jolting is an intentional procedure of some operators, who find that it gives better taste removal during severe troubles. Jolting, or seeding the filter with carbon, is effected as follows: 1. Close the influent and effluent valve; 2. Open washwater valve sufficiently to cause noticeable bubbles in the filter; 3. Shut off washwater valve and allow filter to stand idle for 10 minutes; 4. Place filter back in service.

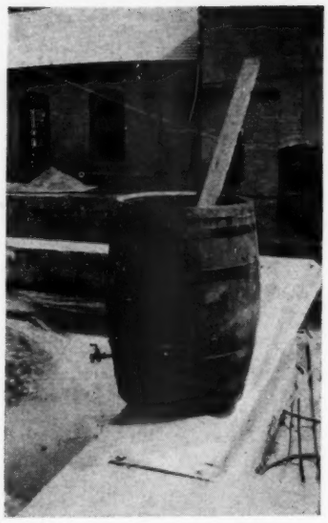
In applying carbon to softening plants of the draw and fill type, it is added direct to the milk of lime and soda solution (12 to 16 lb. per mg.). With continuous-type plants the application is the same as for a regular filtration plant. Dosage of carbon in the pretreatment is very important to stabilize the large amount of sludge produced by the softening chemicals. Supplementary dosing of filters is necessary if odors pass through the softening basin.

Where slow sand filters with coagulation are used, a suggested dosage applied with the coagulants is 5 lbs. of carbon per mg at the entrance of the settling basin and an additional 5 lbs. applied by solution feed direct to the water flowing to the slow sand pits. Initiative in the use of carbon with slow sand filters is credited to Jordan of the Indianapolis Water Co.

Filling the hopper of the Nuchar dry feed machine at the Wilmette, Ill., water plant.

For plants without filters, the carbon is preferably mixed with the alum, and settles with the floc. If a dry-feed machine is used, it is advisable to have it discharge at the same point as the alum solution.

Where impounded water is not regularly treated and taste and odor troubles are caused by algae, carbon is generally applied in connection with copper sulphate treatment; on the day following such treatment a dose of 24 to 40 lbs. per mg of carbon is applied to the surface of the reservoir from a solution barrel mounted on a rowboat, the solution either flowing from a spigot or being dipped from the barrel and slurried over the surface.



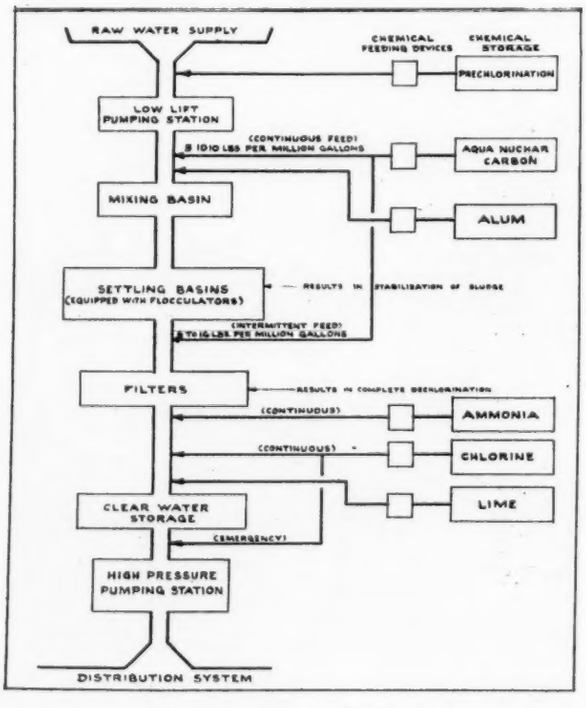
Emergency solution-feed barrel

The most recent use of activated carbon for improving the treatment of water supplies has been to apply carbon to washwater. By this method of application the carbon particles become thoroughly impregnated within the entire filter unit, including the upper layers of fine gravel and the lower layers of coarser sand.

Carbon is applied to the washwater by means of a centrifugal pump, which takes its suction from a 50 gallon barrel in which 8 lbs. of carbon has been placed. This is sufficient to treat a filter of one million gallons per day capacity. This pump should deliver approximately 20 gallons a minute against 20 lbs. pressure.

To treat a 3 million gallon filter, 24 lbs. of carbon is used in the barrel. A concentration greater than 24 lbs. of carbon to 50 gallons of water will feed with difficulty.

This new method of treatment has brought out new and interesting studies in filtration. The carbon stabilizes the organic matter present on the gravel and sand—conditions the filter for more efficient taste removal—and provides a filter with unparalleled dechlorinating efficiency.



Flow diagram for chlorine, carbon and ammonia-chlorine treatment

Activated Carbon and Chlorine

Carbon particles while in suspension in the settling basins do not remove chlorine from solution unless very high dosages are applied (exceeding 24 lbs. per million gallons). Carbon will, however, dechlorinate when the particles are present on the filter sand. Some operators report a trace of residual chlorine present in the finished water after it has passed through a filter containing carbon particles, but upon further analysis they have found this trace of residual is due to factors other than true chlorine.

Activated carbon particles in suspension in the settling basins and on the filters will not interfere with the lasting effect of chloramine sterilization; that is to say, prechlorine and preammonia may be used together with carbon treatment in any concentration, providing a true chlorine residual has been produced. The carbon will adsorb organic matter not attacked by the ammonia and chlorine and in this way produce a more palatable water.

Suggested Method of Taste and Odor Control

The most desired and recommended type of taste and odor control as outlined by most observers is:

1. Prechlorination sufficient to satisfy chlorine demand.
2. Continuous application of Aqua Nuchar carbon in the mixing chamber sufficient to stabilize sludge—5 to 10 lbs. per million gallons.
3. Additional carbon (8 to 16 lbs. per million gallons) applied to the water entering the filters to remove all the existing chlorine residual together with the odor producing compounds present.
4. Following efficient filtration, ammonia and chlorine are added at a ratio of 1 of ammonia to 3 of chlorine.

It is advisable to maintain higher chloramine residuals than true chlorine residuals; that is to say, chloramine residuals are more effective at high concentrations, and in some instances unless high residuals are used the real effect of the chloramine treatment will not be obtained.

Electrical Sewage Treatment

Electrical treatment of sewage to coagulate colloidal matter in the tank effluent prior to filtration has been experimented with at Bradford, England, but "the results obtained have not been up to the standard anticipated, and, coupled with the fact that the cost of current to do the small amount of work is excessive, Mr. Wontner-Smith (engineer of the sewage department) takes the view that the adoption of a similar process on a large-scale working is out of the question," as stated in his report for the fiscal year 1933-1934.

Run-of-Bank Gravel Bases for Pennsylvania Low-Cost Roads

Continuing from the December issue description of base course construction used by Pennsylvania in securing good roads at low cost.

By P. M. Tebbs
Assistant Chief Engineer, Pennsylvania Department of Highways

THESE gravel bases generally have been constructed of ten-inch compressed depth, rolled in two equal layers. The gravel used is selected from the best available local source. In some instances, especially where the heavy surface treatments were used, the gravel carried an excess of loam which resulted in the failure of the surface treatment when we were required to apply this treatment without permitting the gravel bases to carry over the winter. If these bases are maintained under traffic over the winter, however, any excess loam will be washed off or blown off as dust in the spring, so that at the time the treatment is applied we have a hard, bare aggregate surface for the application of the bituminous surface treatment. I am convinced that, wherever possible, bank gravel bases should be carried over the winter until the following June, before surface treatments are applied. This also is preferable in cases where the light penetration (Standard PM-2) tops are used (See PUBLIC WORKS for July, 1934). A more permanent, true surface is procured in this way, as it is difficult to secure ultimate and final compaction by the use of rolling only.

Our gravels generally run quite small, with the exception of occasional large boulders in excess of five or six inches, which are removed from the pavement as spread or at the pit as dug. The gravel is spread through spreader boxes from trucks and deposited on a subgrade, with shoulders formed ahead of the placing of the gravel. The subgrade is drained by scuppers at frequent intervals through the shoulders, either filled with gravel or with the large rejected pieces which are knapped.

It has been found highly desirable to use a bituminous prime coat on the base course for a surface-treated type of top, and in the past year we have been using one-fourth of a gallon to the square yard of heavier cold tar application (Penna. Standard DH Material) for this purpose. After the prime coat has dried sufficiently, we have applied a surface treatment of 100 pounds of Commercial ¾" (Penna. No. 2) chips, and a total of .8 of a gallon of asphalt cut-back (Penna. Class C-2 bituminous material) in two applications, dragging and rolling after the first application. After sufficient curing, which generally requires about three days, this is covered with approximately 10 pounds of ⅝" (Penna. 1-B) chips, followed by an application of a quarter of a gallon of seal coat and about ten pounds of Penna. 1-B chips and thoroughly rolled. We have used many different combinations, but have reached the conclusion that the above has provided our best results.

Concerning the use of gravel with a light penetration (Standard Penna. PM-2) top, we do not use an initial priming treatment and have followed the PM-2 specification, dragging and rolling it after the first application. The seal coat generally is handled very carefully, inasmuch as this feature largely determines the quality of the job. In constructing the seal coat, the best results have been secured by choking with about eight pounds of No. 1-B chips after the second application of oil. This pavement then is allowed to cure under traffic, sometimes as long as two weeks, depending upon weather conditions. It is very essential to have thorough curing of the penetrated course before applying the seal coat. The seal coat then is applied at the rate of one-fourth of a gallon, and in warm weather we have secured best results by the use of hot asphalt rather than continuing with the Class C-2 cut-back which has been used in the penetrated course. Following this application of the seal coat, about ten pounds of chips are applied and rolled. If the surface does not then appear tight, a further seal coat of about .2 of a gallon is applied.

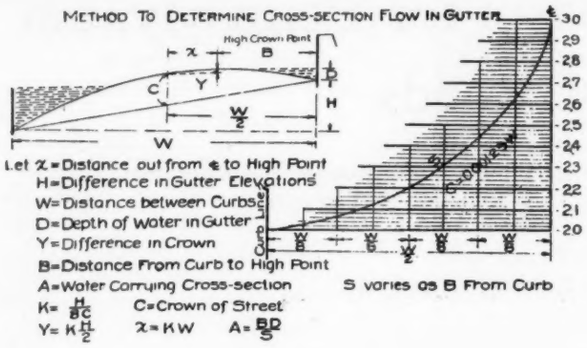
Sometimes we have had to work out the gravel base construction on the assumption that these roads were to be completed as continuous operations during the season in which the bases were placed, rather than to be carried over the winter; however, we do not attempt to treat our gravel roads until they have had at least two months of curing. Our materials will not tie up and become seasoned and hard under the roller only, but require rain and traffic to stabilize them.

We have not determined the exact amount of loam content desirable in bank gravel, although we have done a great deal of experimenting along this line. Some roads have proven excellent with as high a loam content as thirty per cent, while others with practically no loam but a considerable amount of sand have not been so satisfactory. The sand content causes movement in the base material whereas the loam binds readily and when water-proofed is quite stable. The question of loam is not nearly so important when the PM-2 top is used as where the heavy surface treatment is used. In low-cost construction, the character of the local material must be taken into consideration and the method of operation based upon the character of this material.

With the possible exception of some of the earlier ten-foot lane roads, the gravel bases have proved very satisfactory, especially with respect to riding surfaces, and in most instances are the equivalent of our stone bases, especially where we have found it necessary to use the softer sandstone available in the western part of the State.

We have built a few jobs using washed and screened gravel but have experienced a great deal of difficulty in binding them up. In such work we have found loam as satisfactory a binder as either screenings or granulated slag. We have not found that these jobs have retained their riding qualities any better than the roads built with bank gravel.

Where the width of the road must be limited, generally to fourteen or sixteen feet, the trenched type of subgrade becomes essential. If we were building gravel roads twenty-four or thirty feet in width, we would feather out the gravel.



One Man's Idea of Street Design—III

Tangential Streets

By D. Y. Bate

HAVING gotten the profile platted, the designer should check the petition for the job or the work order so that any special specifications may be complied with.

When a petition or work order for a job is received, a file with proper notations as to title and limits should be started immediately and in that file should be incorporated all data pertinent to the job, also a "history card" on which a complete synopsis of the job should be recorded with the date of its occurence. On the history card should be shown the date the profile survey was requested, date completed and the field book numbers, date profile platted and by whom and the profile numbers, date assigned to a designer, the designer's name, class of pavement, and any special items of interest in short form.

From this work order the designer should get his instructions as to desired width of street, height of curbs, width and position of walks and class and thickness of pavement. In some instances the class of material for the paving is left open and determined by alternate bids at the letting of the contract; also, due to surface drainage conditions, the height of curbs may have to be changed from that requested.

Pavement Widths

If the width of pavement is not designated, a width may be determined from the subjoined table which has been prepared and presented by a commission of city planners:

Street Widths	*Roadway Widths*	*Sidewalk Widths*
26 ft.	20 ft.	5 ft. (one side)
30 ft.	20 ft.	5 ft. — 5 ft.
30 ft.	24 ft.	5 ft. (one side)
40 ft.	26 ft.	7 ft. — 7 ft.
50 ft.	30 ft.	10 ft. — 10 ft.
60 ft.	40 ft. (car line)	10 ft. — 10 ft.
60 ft.	40 ft. (business)	10 ft. — 10 ft.
60 ft.	40 ft. (major st.)	10 ft. — 10 ft.
60 ft.	36 ft. (residence)	12 ft. — 12 ft.
70 ft.	46 ft.	12 ft. — 12 ft.
80 ft.	56 ft.	12 ft. — 12 ft.
90 ft.	60 ft.	15 ft. — 15 ft.
100 ft.	74 ft.	13 ft. — 13 ft.

"In respect to the 60-foot widths, it is recommended that on purely residential streets where these are zoned for that purpose, and where excellent tree planting exists with possible ornamental lighting and other improvements adjacent to existing curbs bordering a 30-foot roadway, a 36-foot roadway width be recommended when a permanent improvement is proposed, but that a 30-foot width be permitted if the abutting residents and owners desire to maintain the present condition.

"In respect to the 100-foot streets, the width recommended is given with the understanding that within the metropolitan center and possibly certain other exceptional locations, the predominating need is for pedestrian accommodation, and where also it is found that major building construction has occurred it is assumed that a 70-foot width will best meet the needs. It is intended that these cases where found be treated as exceptions rather than the rule."

Curbs and Curb Corners

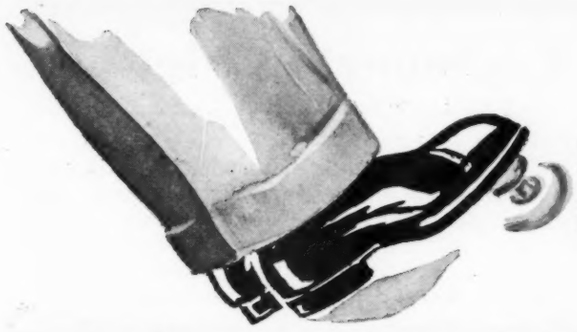
Eight inches should be the standard height of curb face for ordinary cases, but where drainage conditions permit it is desirable to use 6″ on narrow roadways. On residence streets where sidewalks adjoin the curb, always use a 6″ curb face except on steep hillside streets where a 10″ curb face on the dangerous side should be provided. On grades over 20% use 12″ curb face on the dangerous side. The 10″ curb face should be used on streets of 56′, and 60′ widths and the 12″ should be used on 70′ and 74′ or wider streets.

Where a street carries an excess of surface drainage, due to absence of storm sewers, a 12″ curb face should always be used and the grade so laid that the tops of curbs are one foot below the surface of the adjoining property. Where the curb is on fill, reinforcement should be incorporated in it; and, if in conjunction with concrete or concrete base pavement, the curbs should be poured monolithically with the pavement as well as reinforced longitudinally and transversely into the pavement. The base of the curb in all instances should come to the bottom of the pavement slab, thus the curb must equal the height of curb plus the thickness of the pavement.

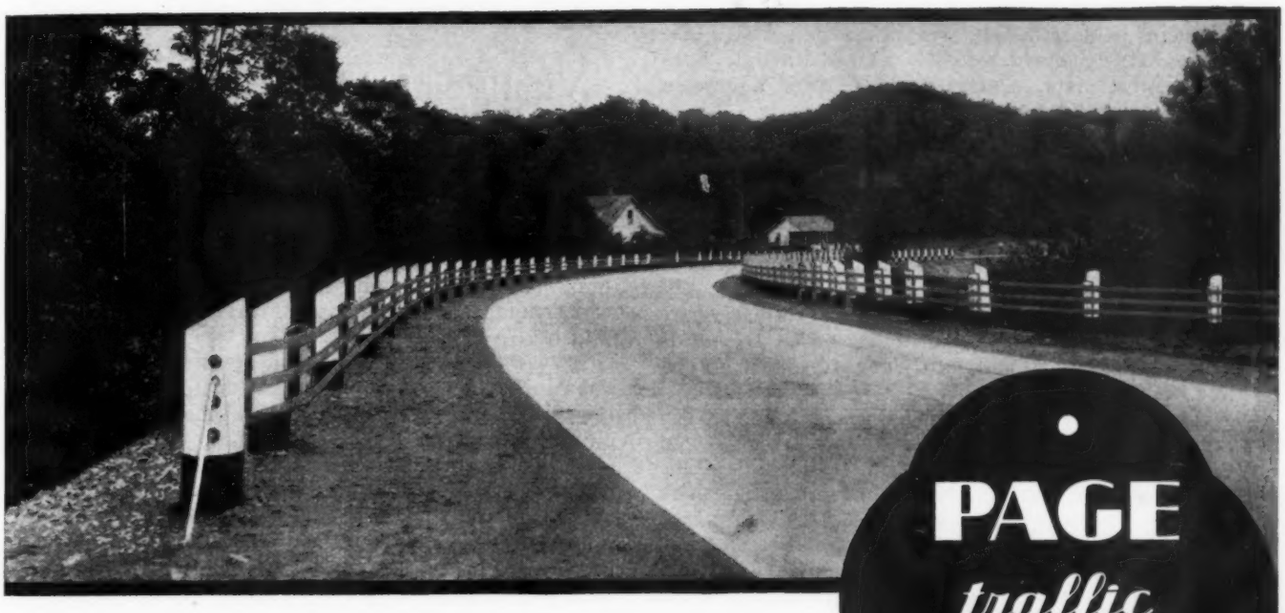
On returns it is well to use one length of radius throughout the job, if possible, thus reducing form work and, consequently, the cost. On returns of approximately right angle intersections the writer uses the following:

60′ & 60′ — 12′ parkway use 22′ radius.
60′ & 80′ — 12′ parkway use 32′ radius.
60′ & 100′ — 12′ & 13′ parkway use 32′ but 33′ is permissible
60′ & 100′ — 12′ & 15′ parkway use 32′ or 35′
80′ & 100′ — 12′ & 13′ parkway use same as 60′ & 100′
80′ & 100′ — 12′ & 15′ parkway use 32′ or 35′
100′ & 100′ — 13′ parkway use 33′
100′ & 100′ — 13′ & 15′ parkway use 33′ or 35′

(Continued on page 37)



PUT YOURSELF IN THE OTHER FELLOW'S SHOES



PAGE *traffic* **TAPE**

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It must *not* injure the car, or its occupants.

It must be neat in appearance, but plainly visible day and night.

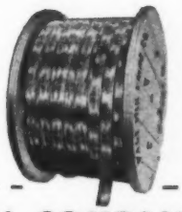
Your highway guard must not take up too much of the taxpayer's money.

It must be quickly, easily, economically erected.

It must "give" horizontally, but not sag vertically.

It must attach to any style or size of posts and be quickly readjusted if pulled loose by some extra heavy impact.

To meet these requirements of THE AVERAGE DRIVER you will, of course, select PAGE traffic TAPE. Comparative tests by Highway Departments are always welcome.



(TEAR ALONG THIS LINE - - -

Notes of the Sanitary Engineering Field

Water Carriage and Incineration of Garbage

What is known as the Garchey system of refuse removal and disposal is in use in two communities in France—Vanves and the garden city of Plessis Robinson, and is being installed in a number of 15-story tenements in Suresnes. In this system the garbage and other small household refuse is washed through pipes to a central plant, using for this purpose the waste water from cooking, washing dishes, floors, etc.

On the under side of the kitchen sink is a reservoir shaped like an inverted dome, with a standpipe waste to prevent overflow. This reservoir receives all the garbage and small refuse and all the waste water. When it is desirable to empty it, the standpipe is raised and all the contents are flused into a system of conduits similar to drains.

These conduct the material to a central station, where the water is allowed to drain to the sewer, the solids then are centrifuged and, partly dewatered, are burned in an incinerator.

An English engineer (from whose report in "The Surveyor" this information is obtained) who visited these plants was unable to obtain any details of the operating costs, but believed it inevitable that there would be frequent stoppage of the drains by tin cans and other objects, that the reservoirs would become foul (and they are not accessible for cleaning), and that burning the water-soaked rubbish and garbage would be difficult and expensive.

Precautions in Using the Osmoscope

The osmoscope, devised by Prof. G. M. Fair and Wm. F. Wells for determining odor in water analysis, has been receiving much attention during the past year. Following a description of it before the American Water Works Association, M. Warren Cowles, health officer, Hackensack Water Co., gave a number of suggestions relative to its use, especially precautions that should be taken, from which we abstract the following:

Scrupulous cleanliness of all the glassware is important in determining the point at which an odor disappears and it was found that, even in standing overnight in an ordinary water laboratory, appreciable odors would collect in the glass apparatus.

Careful ventilation control in the laboratory where tests are made is essential. There must be freedom from the strong odors resulting from other laboratory operations. The sniffing must be confined to odors diluted to approximately the end point or quick fatigue of the nerves in the olfactory area may result. A hot, dry atmosphere in the laboratory during the heating season should be avoided. The common cold and other ailments may likewise interfere. When fatigue occurs, exposure to fresh outside air will help to reduce the effect, but a change of activity for a half-hour is much better.

The sensitivity of the nose piece is most important and apparently is dependent upon several different factors. It must be *comfortable* when held in position in the nostrils. A device which is uncomfortable may produce a reaction not unlike that of a foreign body and greatly interfere with sense of smell. The small nostril tips must be adjustable to fit different persons.

Mr. Cowles had used an all-metal osmoscope and nose piece combined and found that the metal type has a tendency to absorb odors and requires cleaning after four or five tests.

Vital Points in Sewage Works Management

The selection of managers for sewage treatment plants was discussed in November by J. H. Garner, chief inspector of the West Riding Rivers Board, England, before the Institute of Sewage Purification. We think his ideas concerning the requirements of sewage works management are worthy of careful consideration. Said he:

"In sewage works management the first requirement was for the manager to be proud of his plant and job, for with a sense of progress went a sense of responsibility. No plant yet devised would run itself, but a poor plant well operated might easily surpass a good plant poorly operated, yet he had heard it said more than once of intricate and costly new works that everything would be so automatic that there was no need to pay for the services of a skilled manager. The second requirement was to keep the works and plant clean, neat and well-appearing. That was a matter requiring the cooperation of everyone from the Ministry of Health downwards.

"The Ministry might encourage greater attention to the layout of works; engineers should adopt architecturally pleasing designs and see that the works were left in a tidy condition on completion; local authorities should not begrudge a little extra expense in making works more attractive and in providing amenities for workmen; and the manager must do his best to dispel the common idea that a sewage works was the quintessence of all that is abominable. A type of person to be eradicated was that which thinks a spick-and-span sewage works means there is nothing to be done but the cleaning up, and that employees wallowing in filth must needs be the busy, hardworking men.

"The third requirement was to be businesslike in all matters—to keep systematic records of plant operation and control tests and costings of the individual processes. Some knowledge of chemistry should now be a necessity, and even at the smaller works it should be enough to enable the manager to make regular tests of the quality of the effluent, to check the efficiency of works units for control of operation, and to interpret the results of chemical analyses. At the larger works there was every justification for the employment of trained chemists, working in well-equipped laboratories with facilities for conducting some research, even if that did not extend beyond local problems.

"It was encouraging to know that there had been a marked increase in the number of chemists employed in connection with sewage purification. The next step should be to provide the chemists with better facilities for carrying on their work."

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INTERNATIONAL TRUCKS

Road grader spreading stabilizer. U. S. Highway 66 near Holbrook

Keeping Maintenence Crews Moving

By W. L. Carpenter
Superintendent of Equipment, Arizona State Highway Department

ONE of the outstanding problems in the maintenance of our state highway system is equipment. If the engineering division and its maintenance men fulfill their duty to the traveling public, it is essential they have at their command the necessary equipment with which to keep our highways in safe repair.

It is the function of the superintendent of equipment to supply this equipment, deliver it to the job when and where needed, keep a close check on its operations to see that it is properly greased and maintained, in order that the maximum amount of service may be delivered by it at minimum cost.

In order that the above may be accomplished, I have at my disposal four completely equipped shops, situated at Phoenix, Tucson, Ash Fork and Holbrook. The mechanics employed in these four shops and the tools and equipment they have at their disposal make it possible to dismantle and completely rebuild any of the more than 900 pieces of equipment owned by the State Highway Department.

The different types of equipment necessary to maintain our 2900 miles of state highways consist of the following:

Snow removal equipment, of which there are several types; power and pull graders; tractors, both crawler and wheel trucks, ranging in size from 1½-ton to 10-ton capacity; power shovels; rock crushing plants; air compressors; scrapers and road ripping machines; equipment necessary for repairing both concrete and oil-surfaced roads; and numerous other smaller types just as important and necessary in highway maintenance.

In order that the interested reader may understand the functioning of the Equipment Division, I will take for example a piece of highway equipment and follow through its operations from the time it is purchased until it has delivered its maximum amount of service and been returned to the shop and overhauled.

The district engineers' office requests that a piece of equipment be supplied for a certain class of work; for instance, a grader for dragging a gravel surfaced highway. It is my duty to determine the type of grader that will do the work in the most satisfactory, efficient and economical manner.

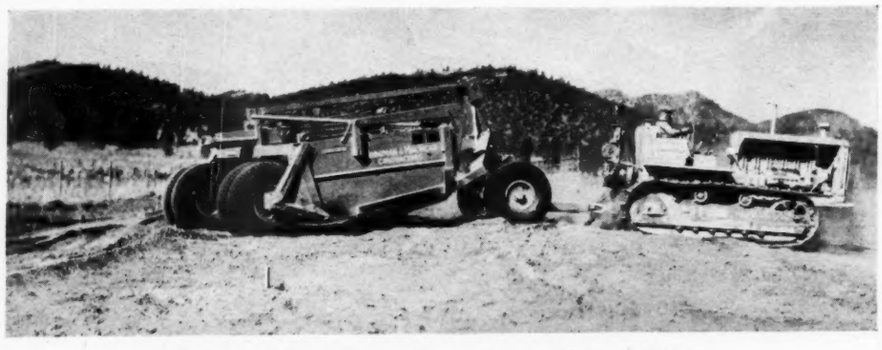
My first procedure is to consult with the engineer in charge of the district in which the grader is to be operated—this being necessary in order to determine the work the piece of equipment will be called on to perform.

From this consultation it is determined that a one-man operated power grader will be the most satisfactory and economical, for instance.

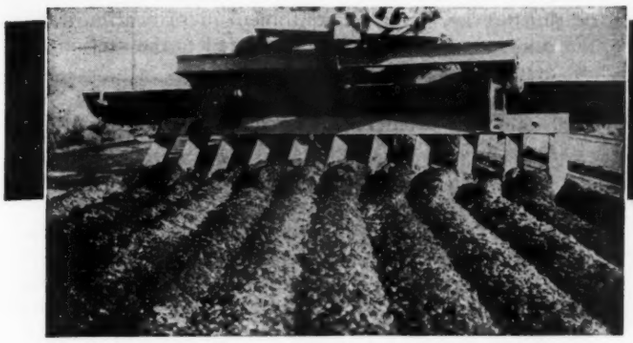
After bids are received and opened, it is my duty to study carefully the specifications submitted by the different bidders and recommend to our state highway engineer and commission the make of grader I find will meet the requirements, and recommend its purchase.

After it is purchased and delivered to the Phoenix yards, a careful check is made to see that it meets fully the specifications as submitted by the firm from which it is purchased. If the grader is built to meet these specifications, a receiving report is issued and it becomes the property of the highway department.

It is then put into the shop and carefully checked for



Tractor and 9 cu. yd. carryall at work on an Arizona highway



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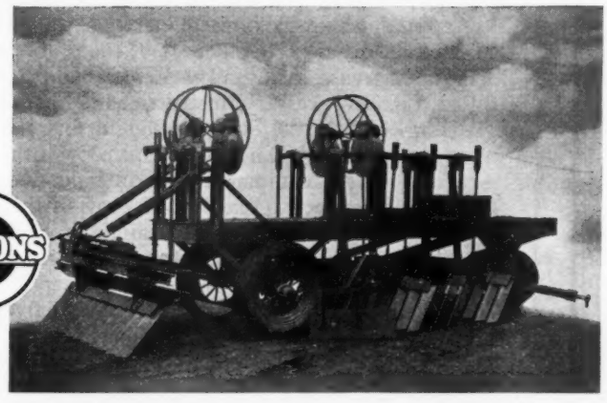

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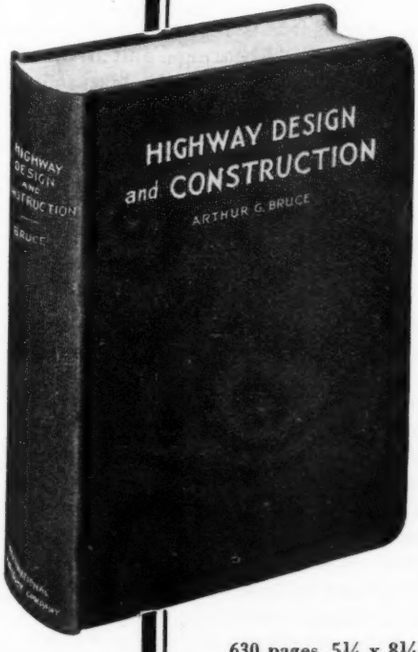
By Arthur G. Bruce
Senior Highway Engineer, U. S. Bureau of Public Roads



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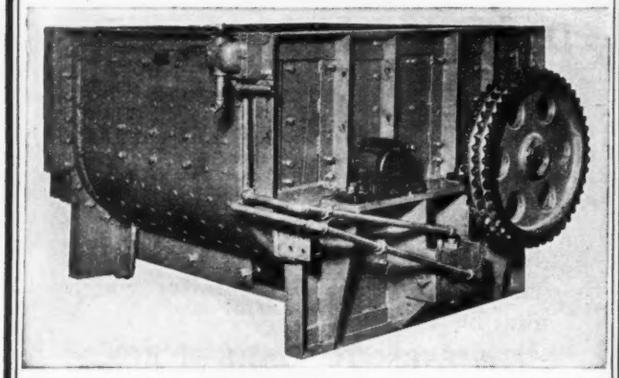

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oil and grease, given an equipment identification number and is then ready to be delivered to the section in the district in which it is to be used.

The grader is then loaded by our power crane onto a 10-ton flat rack truck, and is ready for delivery.

On receipt of the grader by the section foreman, he installs grease and issues an inspection card with instruction to the operator to check different parts of the grader at regular intervals for the necessary greasing, and report any breakage that may occur. With these final touches the motor grader becomes another unit added to the list of maintenance equipment, making its regular trip back and forth over its section, keeping the bumps ironed from the surface of the highway.

At regular intervals one of our two equipment inspectors makes a thorough check of the grader and the operator's grease card, and writes a report as to condition, repairs necessary, instructions to operator as to greasing, etc., in the event he should find the equipment not properly taken care of. One copy of this report is mailed to the equipment superintendent, one copy to the maintenance foreman, one copy to the nearest shop foreman and one copy is retained by him.

These inspectors—Roger Munn, with headquarters in Phoenix, and Frank Gardner, with headquarters in Holbrook — travel constantly over their halves of our highway system, checking equipment and making minor reports. They cover their territory in light canopy trucks, fully equipped with welding outfit and other needed light tools that are not too heavy to carry. They also carry with them numerous small parts, such as carburetors, magnetos, governor assemblies, clutch parts, starters, generators, etc., with the result that there is no loss of time to the piece of equipment, and the expense of sending a mechanic from one of our shops is saved.

Getting back to our power grader, we will assume it has produced its maximum amount of service and is loaded on a truck and returned to the shops for a complete overhaul. Unloading it in the Phoenix yards it is first placed on a wash-rack, where it is thoroughly steam cleaned, and from there taken into the shop and completely dismantled. The motor is reground and fitted with new piston rings, pins and bearings, and all other parts are replaced where required. In the blacksmith and welding department the frame parts are repaired and strengthened. All the worn control worms and gears are taken to the machine shop, where they are machined, fitted with bushings, and new shafts made and fitted to them. The carburetor, magneto, starter and generator are dismantled and rebuilt, broken and worn castings are welded and finished and numerous parts are manufactured, all within our own shops.

Similar care and attention is given to each item of the numerous other type of equipment used in highway maintenance.

In my estimation, one of the outstanding features of our shop operations is the policy adopted within the past year, whereby we manufacture as many of our own parts as possible, with the result that they are made of superior material at less cost, and the money is given to our unemployed citizens instead of being sent out of the state.

In addition to highway equipment, this division owns and maintains all buildings used in the different camps over the state by the maintenance men.

This article appeared in *Arizona Highways* and is republished through the courtesy of Hal Mitchell, Editor.

Street Design

(Continued from page 30)

22′ is about as short as the average car can follow so why make them shorter, harder to drive around, waste paving material and make a dangerous condition at the intersections. Where a tangential street intersects a curvilinear street close to the beginning of a curve, say within 15′ or 20′, never design for the curb return to be on the curve, but continue the tangent and treat as if it were the intersection of two tangents. That little extra piece of curve is useless and makes for an unsightly condition and the additional paving material is usually of no consequence.

The circular length of the curb return should be calculated and noted on the plan, thus,

Curb
Δ=0°00′ 00″
R=.....ft.
L=.....ft.

This notation should be made at some convenient point adjacent to each return.

All alleys should have returns with radius of five feet. Their length, radius and delta should be noted the same as for street returns; also the length of curb to continue the curb back to the property line from the end of the return. Allow for enough curb face to take care of drainage from the alley, but in no case shall it exceed 6″ at the walk and 4″ is preferable.

Amount of Street Crown

There are many formulae for determining the height of the crown, however, the general tendency is to use lower crowns than formerly. Some have used the Rosewater formula. At one time the following was used quite extensively, "On grades of less than 3%, make the rise of crown H equal .0125 of the width of pavement, i.e., 1¼ hundredths of a foot rise for each foot width of pavement. For grades between 3% and 10% use H equals .000125 W (100-2p) in which W equals width of pavement and p equals per cent of grade. On grades of more than 10% use same crown as for 10% grade. Crowns for oiled roadway to be 40% of the above stipulated amount. The above formulae gave rather high crowns which made high speed driving rather uncomfortable due to excessive cross-slope and dangerous in wet weather, also gave rise to the "thank-you-ma'am" effect at intersections to get across the gutters.

A formula quite extensively used in the Southwest is:

H equals $0.000078\ W^2 + 0.22'$ which gives a one foot crown on a 100′ street, is much more comfortable to ride and makes design at intersections to avoid the "thank-you-ma'am" much easier.

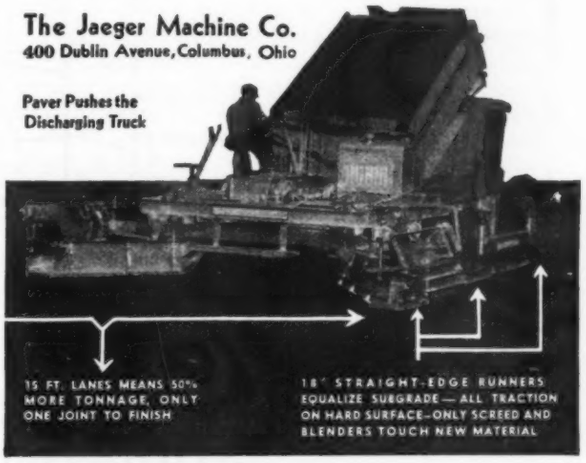
In using cross-slope in a street it is a good idea to limit the amount to 2.5%; or a better method is to take the quarter line (the center of either half of the width) and from its center measure off one-half the width of the tread of the average car (2½ feet each side) and then see that the slope between these two points does not exceed 7% and you will have a comfortable crown on which to drive. The accompanying diagram will show how cross-slope will govern the water-carrying capacity of your street.

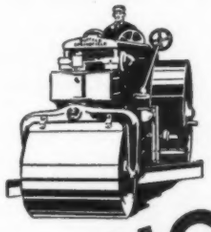
This is the third of a series of articles by Mr. Bate. Another will appear in an early issue.

ADJUSTABLE 9′ to 15′
Smooth as Concrete - No Forms
JAEGER Bituminous PAVER
(400 To 1000 Tons Per Day)

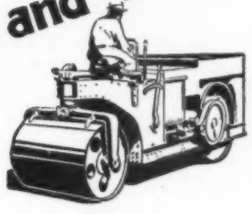
- 18′ Long Straight Edge Runners, full floating, equalize subgrade.
- Telescopic Frame makes width changes easy.
- 4 Rubber-Tired Wheels carry load, run on hard surface. Only screeds touch newly laid material.
- Adjustable Blender Screed at rear of each Runner.
- Differential Steering.
- Get our CATALOG BP-2—real news on 1935 methods and machines for lower cost, better black top roads.

The Jaeger Machine Co.
400 Dublin Avenue, Columbus, Ohio


Paver Pushes the Discharging Truck
15 FT. LANES MEANS 50% MORE TONNAGE, ONLY ONE JOINT TO FINISH
18′ STRAIGHT-EDGE RUNNERS EQUALIZE SUBGRADE — ALL TRACTION ON HARD SURFACE-ONLY SCREED AND BLENDERS TOUCH NEW MATERIAL



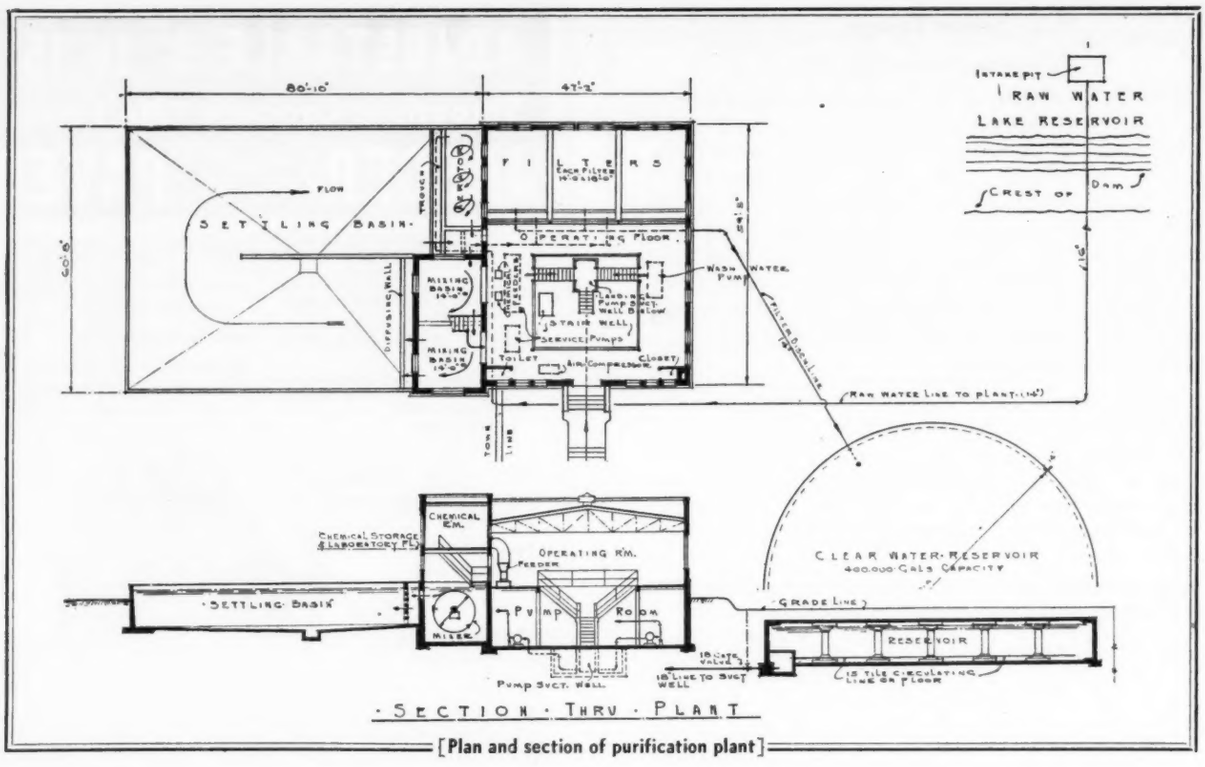
BUFFALO-SPRINGFIELD
Three Wheel and Tandem



Buffalo-Springfield's complete range of models in both three-wheel and tandem rollers permits the purchaser to select the proper machines for his work.

Full details will be furnished on request.

THE BUFFALO-SPRINGFIELD ROLLER CO.
SPRINGFIELD, OHIO



[Plan and section of purification plant]

Filter Plant Built With Profits From Municipal Light Plant

Aided by PWA Grant. Utilities Profits Relieve Citizens of All Taxes

By Chas. Brossman
Consulting Engineer, Indiana

HUNTINGBURG, Indiana, a city of 3500 population, is tax free, thanks to its publicly owned water and light utilities, and yet enjoys low rates; which combination is due to the efficient operation of the works by the city officials.

The original works were built by the city in 1893, comprising pumping plant, mains and elevated tank. Steam pumping was soon changed to electric, using current furnished by the municipal lighting plant; and the capacity of the works has been increased from time to time. The supply is obtained from impounded surface water, and for years the State Board of Health has been advocating a proper filtration plant from the standpoint of health and sanitation; while algae troubles causing tastes and odors, and turbidity, had given trouble.

When the opportunity of Federal aid for water works construction was offered in 1933, the author was employed by the city on June 21st to prepare plans for a filter plant and endeavor to secure a loan, and the first application for a loan for water works under the Indiana

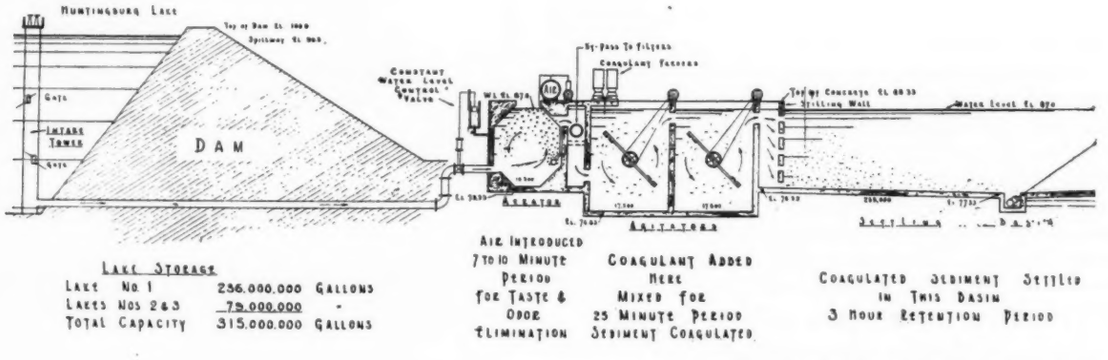
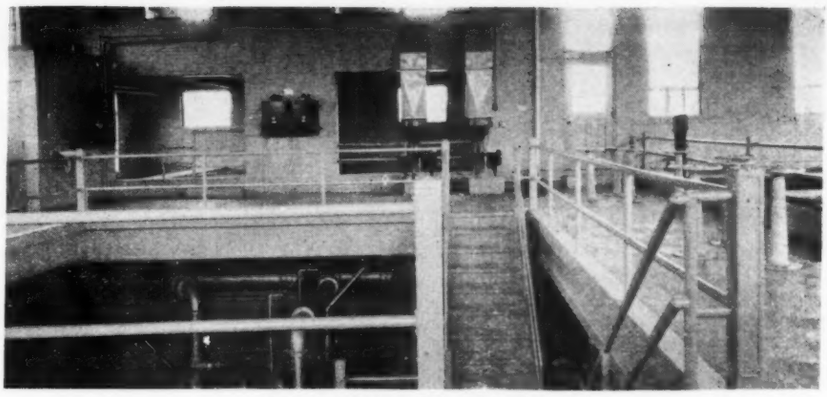

HUNTINGBURG LAKE
DAM
INTAKE TOWER
AERATOR
AGITATORS
LAKE STORAGE
LAKE NO 1 236,000,000 GALLONS
LAKES NOS 2&3 79,000,000
TOTAL CAPACITY 315,000,000 GALLONS
AIR INTRODUCED 7 TO 10 MINUTE PERIOD FOR TASTE & ODOR ELIMINATION
COAGULANT ADDED HERE MIXED FOR 25 MINUTE PERIOD SEDIMENT COAGULATED
COAGULATED SEDIMENT SETTLED IN THIS BASIN 3 HOUR RETENTION PERIOD

Diagram of water purification process and

office of the Federal Emergency Administration of Public Works was for Huntingburg's filtration plant. This was accepted by Washington, which agreed to grant the city $23,000; the total cost of the work being $87,677, of which $84,004 was for the filter plant and the remainder for a power line between it and the light plant and some miscellaneous items. The money furnished by the city was from funds accumulated by the light and water plants. Bids were received on October 13, and on December 26 contracts were signed with the Paterson Engineering Co. for the general plant; the Chicago Bridge and Iron Works for improvements to water tanks, and the American Cast Iron Pipe Co. for pipe. Bad weather delayed the work, but it was completed early in September, 1934.



Interior of Huntingburg Filter Plant

Most of the labor—39,000 man-hours—was local; the brick was locally made, and where possible, material was obtained from local firms. This kept a great portion of the money right in town and helped the city very materially.

The Filtration Plant

The present average domestic consumption is 400,000 gallons per day. The new plant was designed for a consumption of 2 mgd., three filters being designed, but only two with a combined capacity of 1.5 mgd being equipped for present use. The treatment consists of aeration by means of air diffusion, coagulation and filtration through gravity rapid sand filters.

On reaching the plant through a 14-inch pipe, the water passes into an aerating chamber in which compressed air at about 5 lb. pressure is introduced through five separate units, being distributed through diffuser tubes made by the Carborundum Co., which are located about 6 ft. below the water surface. The water takes seven to ten minutes to pass through the aerating chamber. This chamber may be by-passed, but is especially important during times of algae trouble or when ice prevents surface absorption of oxygen.

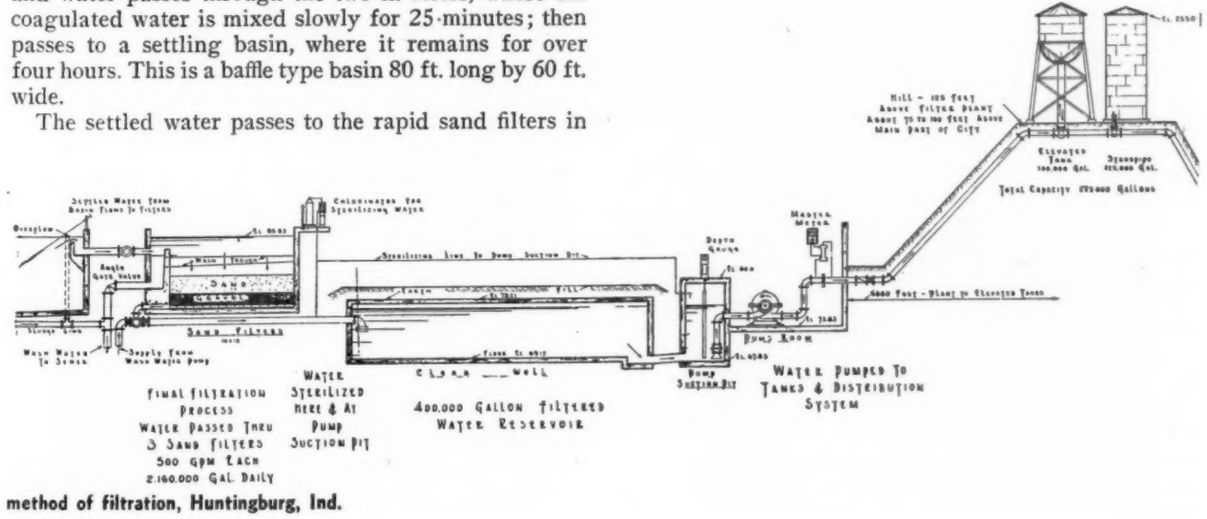
The water then passes to two mixing tanks 14 ft. square and about 12 ft. deep, where it receives coagulant fed by means of International dry feeders. Each mixing tank is provided with a Dorr Co. flocculator, and water passes through the two in series, where the coagulated water is mixed slowly for 25 minutes; then passes to a settling basin, where it remains for over four hours. This is a baffle type basin 80 ft. long by 60 ft. wide.

The settled water passes to the rapid sand filters in cells 14 by 18 ft., which have a nominal capacity of 500 gpm each. Wagner block underdrains support the filter medium of 24 in. of Ottawa sand on 15 in. of graded gravel. "International" operating devices, manually controlled, are used. The filtered water is chlorinated and passes to a 400,000 gal. clear water reservoir, and from this to a pump well, from which it is pumped 1.25 miles to an elevated tank and standpipe with a combined capacity of 225,000 gallons.

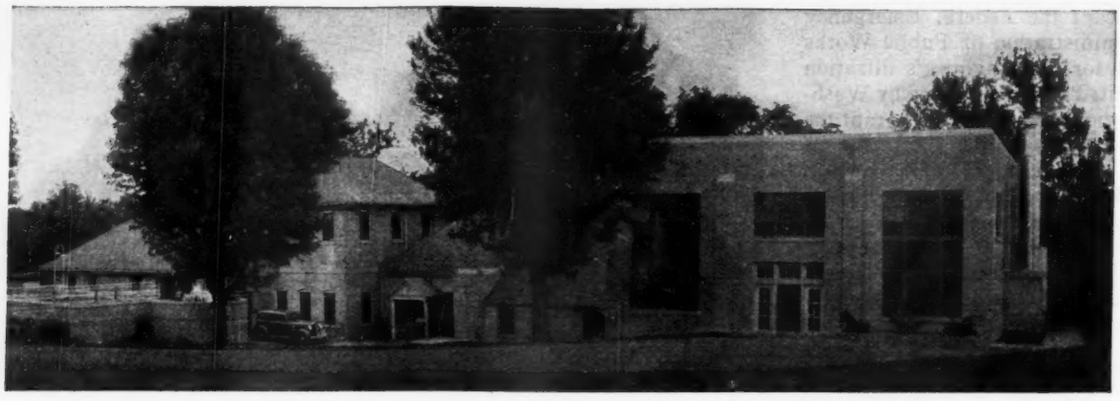
The pumping equipment consists of one dual-drive 1,000 gpm pump connected to a motor on one end and gasoline engine on the other; two 750 gpm motor-driven pumps, and one 4,000 gpm wash-water pump. All pumps are of Dayton-Dowd manufacture and all motors and the switchboard are Westinghouse make. Complete equipment of Republic Flow Meter Co. pressure indicating and recording instruments are provided. In the pump room also is an air compressor for the aerating system; and a 500 gpm booster pump, for emergency use in case the water in the reservoir falls below the level of the aerating chamber in a dry season.

There is a laboratory for making the customary tests, which is heated by steam radiation. The main filter room is heated with unit heaters which circulate the air.

Leo Grewe is superintendent of the water and light department. Edwin J. Lukemeyer is Mayor. J. R. Monoghan was the Federal government's direct representative on the work. Donald Graham was State engineer inspector, and Forrest M. Logan was State Federal engineer.


SAND
GRAVEL
Sand Filters
Pump Room
Water Sterilized Here & At Pump Suction Pit
400,000 Gallon Filtered Water Reservoir
Water Pumped To Tanks & Distribution System
Final Filtration Process
Water Passed Thru 3 Sand Filters 500 GPM Each
2,160,000 Gal. Daily

method of filtration, Huntingburg, Ind.



New Municipal Light and Power Plant recently erected by the City of Paris, Ky., in conjunction with its water pumping plant.

Paris, Kentucky, Wins Its Fight for Municipal Ownership of Utilities

THE City of Paris, Kentucky, some 20 miles north of Lexington, having a present population of 6,210, has recently completed the installation of its own municipal light and power plant, which is already returning a handsome profit to the citizens. The acquisition of this municipally owned utility comes as the culmination of a long period of litigation but the results have justified the effort put forth.

Under the Kentucky laws many handicaps were encountered in operating the municipality with a councilmanic form of government, and to take advantage of the broader powers conferred upon cities under a commission form of government, the city made this change and in January of 1930 began functioning with a mayor and four commissioners. The citizens of Paris had long been subjected to what they considered excessive rates for both water and electricity as charged by the two private utilities serving the city. Every new administration for the past 20 years had endeavored to secure relief from these rates but without effect. The first step towards the successful solution of the problem lay in the change in the form of government.

Immediately upon taking office, the board was petitioned for a new franchise by the company supplying the water. Since the rates contemplated in this offer were excessive it was decided to issue mortgage bonds for the purpose of financing the purchase of the water system which had long been inadequate for the city's needs and had been allowed by the owners to reach a state of disrepair. The city by negotiation took possession of the company's holding in April, 1931, and immediately proceeded to practically rebuild the entire system.

This work was completed in the latter part of 1932 and the utility proved, even with reduced rates put into effect, to be a lucrative undertaking from which the income was more than ample to take care of interest obligations and provide for retirement of the bonds.

In the meantime the private utility serving electricity had, upon the expiration of its franchise in 1929, asked for a new one predicated upon a room basis of 6 kw. per room, 8 cents per kw. for the first block and 7 cents for the second. While this seemed to be a reduction over the former rates starting at 10 cents on a straight consumption basis, it meant, in effect, an increase of about 20 per cent in the average consumer's bill. The previous rate of 10 cents had in itself been a reduction from a prior rate of 13 cents put into effect when agitation for a municipal plant was instigated.

With the advent of the municipal light plant the top block was dropped to 7 cents and the meter deposit formerly demanded was eliminated. In addition various kinds of concessions were offered to hold such of their customers as were still using utility current.

There is a law in the State of Kentucky which specifies that once a utility holds a franchise the city must, 18 months before its expiration, offer for sale a similar franchise. In effect this means that the franchise is perpetual and as such its legality is questionable.

In spite of the litigation and the handicaps thus imposed the commission decided by resolution in October, 1930, to submit the choice for or against a municipal light plant to a vote of the people. In the following month a proposition to authorize an indebtedness on behalf of the city in the sum of $150,000 for the purpose of building a municipal light plant and distribution system was voted by an overwhelming majority of 2,229 to 180. Since, however, the city was engaged at that time in the rebuilding of the water system, the question of a light plant was held in abeyance until June, 1932, when an ordinance was passed for the issuance of the necessary bonds.

Although the bonds for the water works amounting to $425,000.00 were payable as to principal and interest out of earnings only, the utility attempted to prove that they were in reality a direct obligation of the city in which case the municipal light plant bonds, which were direct obligation bonds, would have been an issue in excess of the legal limitations of the city.

The courts found these contentions to be without basis at law but in this respect it should be pointed out that an ordinance has since been passed making the interest charge and maturity charges a first obligation on the earnings of the light plant. It is anticipated that all bonds will be so retired and the financial statement reproduced herewith for the six months ending August, 1934, indicate that this anticipation will be fulfilled.

After the legal matter was cleared up the commissioners placed the bonds on the market and took bids on the necessary equipment for the new plant. It was

decided that the light plant should be built in combination with the water plant on the banks of the picturesque Stoner creek about a half mile east of town.

After a careful consideration of the relative merits of various types of equipment necessary for a generating station, the commission decided to install Diesel engines and subsequently awarded the contract to Fairbanks, Morse & Co. for the complete installation. The utility company at this point brought an injunction suit against the contract, but since they declined to post bond to make it permanent it was thrown out and work was begun. Once started the work of the construction and installation went forward apace and the plant was ready for operation in November of 1933.

The power plant building is one of the best in the city, constructed of fine buff-colored face brick and of the highest grade materials throughout, including terrazza flooring. The architectural work was done by E. C. Landberg of Cincinnati, the distribution system by Bouligny & Co. of Charlotte and the building proper and foundations were erected by E. T. Sheeler & Son of Paris.

There are installed in the plant two Fairbanks-Morse 5-cylinder 525-hp. Model 33-D-14 Diesel engines with direct connected 4,000 volt F-M alternators and direct connected exciters. The switchboard runs flush with the inside wall and all switches and current-carrying equipment are located seven feet back of it in an alcove which houses nothing but the electrical equipment and switchboard. All accessory equipment is located in the basement and is controlled from push buttons with pilot lights located on the instrument panel in the engine room. All piping, where practicable, including the air intake and the exhaust is of welded construction. Silencers are fabricated to F-M design and have proved to be entirely effective in the elimination of any objectionable exhaust noise. The large hot well is of reenforced concrete construction and is located in the basement with a man-hole opening through the engine room floor. All pumps including raw and soft water circulating pumps, oil transfer pumps and lubricating oil pumps are so installed as to have a positive suction head to eliminate all necessity for priming. Heat exchangers are assembled in a vertical position at the end of each engine foundation and so installed that the nest of tubes may be withdrawn for cleaning through suitable openings in the floor by the use of the overhead crane. Altogether the plant presents an extremely pleasing appearance and is of very compact arrangement with extra space provided for the installation of an additional unit when the load may require it.

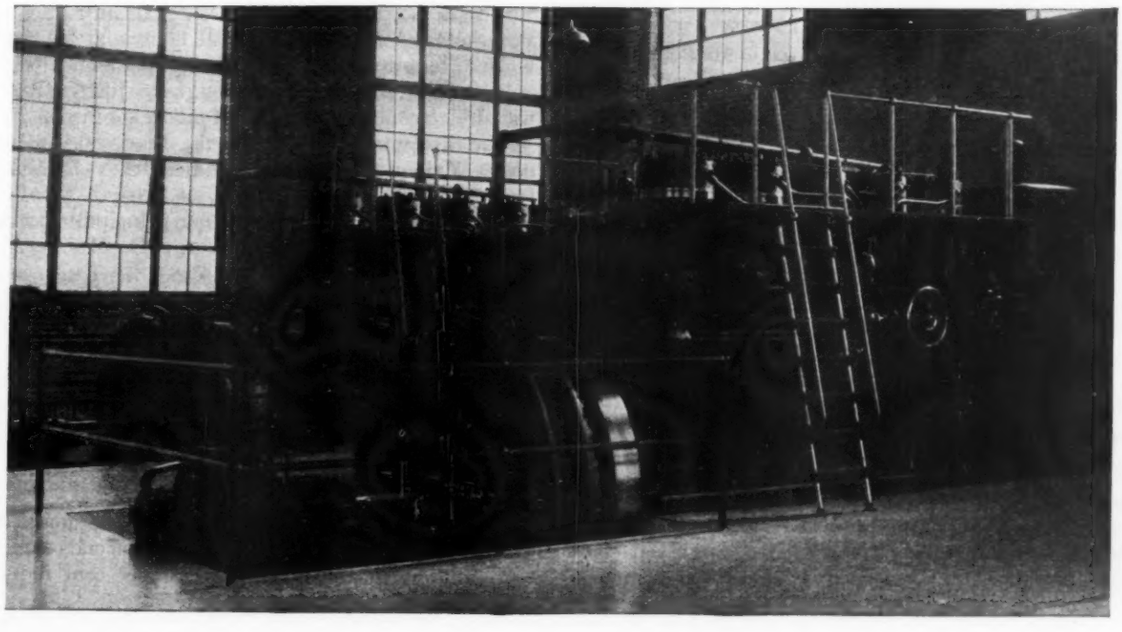
Six Months Operating Statement, Paris, Ky.

1934	*Total Income*	*Total Operating Expense*	*Operating Profit*
March	$3,273.37	$861.57	$2,411.80
April	3,269.62	711.29	2,558.33
May	3,535.85	520.50	3,015.35
June	3,561.19	647.86	2,913.33
July	3,523.08	2,052.92	1,470.16
August	4,052.11	1,342.91	2,709.20
Six months	$21,215.22	$6,137.05	$15,078.17

Although the city is charging exactly the same rates as the private utility, it has been very successful to date in acquiring customers and now has upwards of 75 per cent of the total load of the city. Already the demand has increased to such a point that it has become necessary to install the third unit. On May 29th of this year bids were received for a unit to increase their facilities. The contract for this engine was awarded to Fairbanks-Morse and the unit is now being installed. It is of a 1050-hp. Model 33-D-16 Diesel equipped with a Woodward governor and all accessories duplicating the original installation.

The installation of this unit will exactly double the capacity of the plant, making it 2100-hp. That it is needed and can be paid for from surplus income is evident from the operating figures covering the six months period from March to August inclusive of this year. It will be noted that these figures indicate an operating profit in excess of $15,000.00 for the period considered which is at the rate of more than $30,000.00 a year. This sum is clear profit to the city and represents an income that would not have been available under private ownership of a utility, yet it represents no additional disbursement from the pockets of the citizens of Paris.

Two Fairbanks-Morse 525-hp. Diesel engine generating units recently installed in the Paris, Ky., municipal plant. Already the increased load has required the installation of a third unit.



Have You Heard?

Three South Carolina Counties Plan Miniature "TVA"

In February 1933 the South Carolina state legislature passed an act creating the Lyles Ford Tri-County Authority enabling Union, Newberry and Fairfield counties to develop hydro-electric power on the Enoree, Tiger and Broad rivers. The War Department after a three years survey of tributaries of Santee-Cooper rivers to control flood waters on said rivers recommended the location of dams on Enoree, Tiger and Broad rivers as a joint project, among nine others.

The contemplated development requires a dam on Enoree 90 feet high to divert the water, through a tunnel 15½ feet by 13½ feet, into Padgett creek; a dam on this creek 85 feet high would put water across ridge into Tiger river basin—a dam of 96 feet on Tiger would create a pondage area of 20,000 acres, with 748,850 acre-feet, and the War Dept. recommends installation of 27,800 hp. at a cost of .55 ct per kwh. Tiger River would discharge into Broad and a dam on Broad at Lyles Ford would create a pondage area of 5,400 acres, with 81,250 acre-feet, but as this dam backs water to Tiger dam it would have the advantage of the 748,850 acre feet of storage. Installing 27,000 hp. at a cost of .279 ct per kwh, the project would represent 54,800 hp. at an average cost of .414 ct per kwh. All four dams would contemplate a unit in flood control of Santee-Cooper basin.

The development will be through the P. W. A. without any financial liability to county or state, but after 70% is repaid the government the counties jointly will own the plants; to operate at a profit to reduce taxes or at a small margin over cost to allow the citizens in city or country electric power as cheap as is offered the people anywhere in the United States.

The construction of the pond and the use of the power will serve the following purposes:

(1) To create work and relieve unemployment.

(2) To supply rural electrification and make it available to every home in country.

(3) To supply current at low price to municipalities, to create and attract new enterprises and supply present industries at lower figures than at present.

(4) To develop natural resources, recreation parks, fishing preserves etc. etc.

The cost of the combined projects is estimated to be around $8,500,000. Officers of the Lyles Ford Tri-County Authority are: L. G. Young, Chairman, R. M. Blair, Secretary and A. E. Reese, Treasurer. The Chairman is located in Union, S. C.

Electric Home and Farm Authority Reports Progress

Since its incorporation on January 17, 1934 as a subsidiary of the Tennessee Valley Authority, the Electric Home and Farm Authority has made available a new plan for financing retail sales of approved electrical appliances, at lowered prices and lowered financing costs to approximately 375,000 home users of electricity in parts of Tennessee, Alabama, Georgia and Mississippi. The articles of incorporation authorize operations in every state but for the present its activities are being confined to the Tennessee Valley region. While EHFA is first and last a consumers' program, its activities will unquestionably prove beneficial to electric manufacturers and their representatives.

EHFA works with and through existing manufacturers, retailers and electric power distributors. It makes no appliances, does no selling and is not in the power business. Seven manufacturers of electric refrigerators, nine manufacturers of electric ranges, and eleven manufacturers of electric water heaters have joined the Authority's program for marketing low-cost, standard quality appliances at prices and finance costs which make their use economical for families of average means. In addition to these domestic appliances, EHFA began, December 10, 1934, the financing of deep and shallow well pumps, with twelve manufacturers cooperating.

The low charges and long terms, in conjunction with the low retail prices required for EHFA approval of an appliance, have materially reduced the costs of electrical appliances in the areas served by TVA and EHFA.

Approximately 300 independent retail dealers, and the retail departments of three power companies, are participating in the selling of EHFA approved and financed appliances. A comprehensive educational program has been undertaken. It is intended by that means to help home makers obtain the greatest possible benefits from electricity at the least possible cost. Sales figures collected by private agencies not connected with EHFA indicated that amid a nation-wide upswing in appliance sales, the sales increases in the area affected immediately by EHFA and TVA exceeded the increases recorded in other sections.

The plan in force provides that the buyer of an approved electric refrigerator, range, water heater, or electric pump sold by an authorized dealer in an authorized locality may pay for the equipment in three years if one appliance is bought, or in four years if two or more appliances are bought. The interest charges, and a small additional charge for bookkeeping and collection costs, are substantially lower than any previously available to buyers of electrical household equipment. EHFA requires that its financing plan may be used only where rates are low enough to justify the full use of electricity by families of moderate income.

The directors of EHFA are the directors of the Tennessee Valley Authority. They are Dr. A. E. Morgan, David E. Lilienthal, and Dr. H. A. Morgan. Mr. Lilienthal is president of EHFA. Other principal officers are F. J. Carr, treasurer, and George D. Munger, commercial manager.

Christmas Gift to Electricity Users in Fayette, Mo.

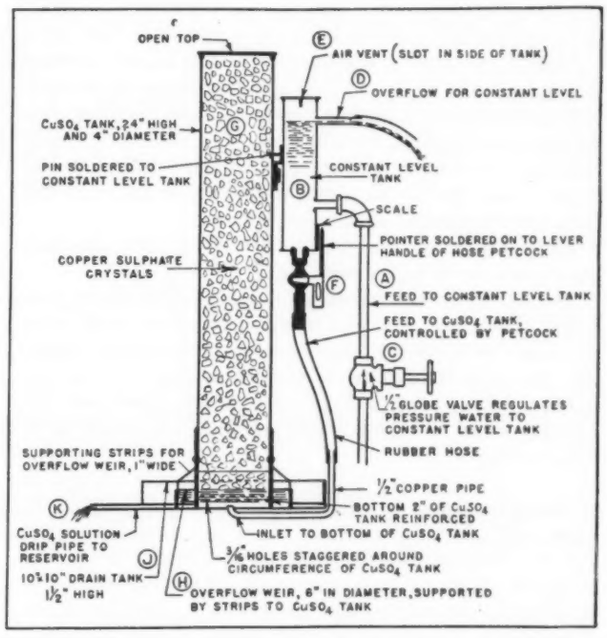
Electric light users, who obtain their power from the Fayette, Mo., municipal plant, were given half of their month's bill free for a Christmas present on December 24th.

Only half rate will be charged for the month from December 15 to January 15, company officials said. The "present" is in addition to the 10 per cent reduction made on all monthly bills.

Following is a digest of the important articles published last month having to do with water works design, construction and operation and water purification, arranged in easy reference form.

The Water Wheel

COPPER sulphate is applied to impounding reservoirs continuously by the Hackensack Water Co., and also to open distributing reservoirs during the summer months. This is to prevent continual seeding with microscopic organisms by the inflowing streams, which organisms are an important source of odor and taste troubles in many water supplies; and this continuous application of copper sulphate, combined with the use of activated carbon, has resulted in very material improvement in odor control. It "has assisted materially in keeping the seasonal growths of such organisms as anabena, asterionella, synedra, melosira and synura below the point at which they become troublesome. . . . The limitation of plankton growth not only results in greater freedom from odors and tastes but maintains the water in a condition much more favorable to subsequent treatment in the rapid sand purification process. In this respect the expense of such copper sulphate treatment is largely offset by savings effected in chemicals for coagulation and sterilization." The illustration shows a type of special apparatus devised for the continuous application of copper sulphate.[A1-14]


OPEN TOP
AIR VENT (SLOT IN SIDE OF TANK)
OVERFLOW FOR CONSTANT LEVEL
CuSO4 TANK, 24" HIGH AND 4" DIAMETER
PIN SOLDERED TO CONSTANT LEVEL TANK
CONSTANT LEVEL TANK
SCALE
POINTER SOLDERED ON TO LEVER HANDLE OF HOSE PETCOCK
COPPER SULPHATE CRYSTALS
FEED TO CONSTANT LEVEL TANK
FEED TO CuSO4 TANK, CONTROLLED BY PETCOCK
½" GLOBE VALVE REGULATES PRESSURE WATER TO CONSTANT LEVEL TANK
RUBBER HOSE
SUPPORTING STRIPS FOR OVERFLOW WEIR, 1" WIDE
½" COPPER PIPE
BOTTOM 2" OF CuSO4 TANK REINFORCED
CuSO4 SOLUTION DRIP PIPE TO RESERVOIR
INLET TO BOTTOM OF CuSO4 TANK
3/16" HOLES STAGGERED AROUND CIRCUMFERENCE OF CuSO4 TANK
10"x10" DRAIN TANK 1½" HIGH
OVERFLOW WEIR, 8" IN DIAMETER, SUPPORTED BY STRIPS TO CuSO4 TANK

Continuous Copper Sulphate Application Apparatus as Used by the Hackensack Water Company

Pressure water (*A*) to constant level tank (*B*), regulated by globe valve (*C*). Overflow (*D*) with air vent (*E*) maintains constant head on tank (*B*). Rate of flow from tank (*B*) controlled by lever handle of hose petcock (*F*) which has a pointer soldered on lever handle, and reads on a scale attached to tank (*B*). Feed from tank (*B*) enters bottom of $CuSO_4$ tank (*G*) (which has a number of 3/16-inch holes around its circumference) and then to a 6-inch in diameter overflow weir (*H*) 1 inch high, around base of tank (*G*). Feed from tank (*B*) maintains 1 inch depth in $CuSO_4$ tank (*G*), overflow of $CuSO_4$ solution spills over overflow (*H*) and into drain tank (*J*) and through overflow or drip pipe (*K*) to reservoir.

Ferric salts as coagulants, formerly almost prohibitive in cost, can now be had at figures which allow them to compete with alum. The following advantages of their use have been reported: 1. Coagulation is effective over a much wider pH range than with alum. Color flocs may be formed in the very acid range, where alum may not be employed. On the other hand, true hydrated ferric oxide flocs may be formed at pH 9-10 or even higher for the removal of turbidity and manganese. 2. The time required for floc formation, conditioning, and settling is in many cases considerably shorter than that required for alum. 3. Filter runs have been markedly increased in several cases. 4. Manganese is successfully removed at pH values above 9. 5. Effluents may be produced which are exceedingly low in both iron and aluminum. 6. Hydrogen sulfide is removed, and taste and odor improved. 7. Ferric floc does not seem to stick to sand grains to form mud balls, and is subject to less "breaking through" on the filters.[A1-13]

Acid water from the Monongahela river used by the South Pittsburgh (Pa.) Water Co. caused trouble in filters—the formation of a gummy mat, in which striated cracks appeared, and broken pieces of the mat formed mud balls when the filter was washed. The equivalent of the acid salts of aluminum in the raw water in terms of alum ran as high as 10 grains per gallon. The water was softened by the lime-soda process to 100 p.p.m., then coagulated with a phenolphthalein alkalinity of 1-3 p. p. m. before filtration; the pH being about 7.6. The water contained 2-15 p. p. m. of aluminum in solution, part of which precipitated on the filter, the aluminum content of the filter effluent being 1-10 p. p. m. By laboratory experimentation it was found that when the pH of the settled water went below 6.8 the iron salts were incompletely precipitated, and above 7.0 the aluminum salts were incompletely precipitated. So the water is kept as near 6.9 as possible, and there has been no more trouble with cracked mats or excessive mud balls, and the effluent contains less than 1 p. p. m. aluminum in solution. Following filtration, a clear solution of lime is added to the filter effluent to give a pH of 7.5 to prevent red water troubles.[AA12-2]

Chemical dust from lime, carbon, alum etc. should not be allowed to circulate and settle in the filter room when it is fed to the machine hoppers or when the floor is brushed up. It can be prevented by enclosing all dry type chemicals and dispensing machines in a separate room, and by using a vacuum cleaner and flushing hose for cleaning the floors; for which purpose filter plants should be provided with vacuum cleaning systems and hose connections, drains and curb walls.[AA12-6]

For thawing water pipes "the simplest and best electrical outfit is a d. c. generator having a current capacity of 400 to 500 amperes at 115 volts, with proper field regulation, and driven by a gasoline motor. . . . From our experience it would seem that a current of

approximately 400 amperes would do the work in a few minutes, and a mimimum amount of danger to the water pipes would obtain. There is some danger in using currents in excess of 400 amperes in unduly heating the joints of the water pipes which probably have a higher resistance than the pipes themselves. . . . I want to stress the importance of disconnecting all ground wires for it is possible, under certain conditions, especially where the service pipe has become broken due to freezing, to pass heavy currents over the metal coverings of house wiring, heating them at times to such an extent that fires have actually been started."[B11-8;A12-8] Several more or less serious fires have been started in this way. In many cases it is necessary to keep water flowing through a pipe for some time after thawing to prevent it freezing again. Boston recommends the thawing outfit described above. In Portland, Me., before electric thawing, the service is disconnected entirely inside the house, right inside the cellar wall if possible, and the meter and a piece of pipe taken out.

Copper pipe is thawed by electricity, but requires about twice as long as steel pipe.

Several cities thawed large mains by drilling a hole in the top of the pipe and pushing into it a small pipe of copper or block tin connected to a steam boiler, pushing the pipe further in as the ice melted. For steam, Milton, Mass., used a 5 gal. galvanized tank sold for heating water in barber shops, with gauge, relief valve, etc., costing $15.[B11-9]

A frozen water tank in Concord, N. H., 28.75 ft. diam. and 23 ft. high, with a 5 ft. riser, froze, ice being 2½ ft. thick around the sides, bottom and top. Ice was chopped out of the tank, but the riser stayed frozen for 2½ weeks when the sun thawed it. Apparently no damage was caused to the tank.[B11-9]

Silting of reservoirs may be a serious matter. Austin reservoir, from which Austin, Tex., derives its water supply as well as power, built in 1913 (the second one at this site) had lost 95.6% of its capacity by silting by 1926—83.5% during the first nine years, or about 3,000 acre-feet per year. Three remedies can be considered—preventing the erosion of the water shed and valley from which the silt is brought, dredging out or otherwise removing the silt from the reservoir, or abandoning the reservoir and building another. The last may not be possible, but if it is, such successive reservoirs will in time use up all the sites. Dredging is practicable for small reservoirs but not for large ones. (The silt in Austin reservoir was, in 1926, 50 million cubic yards. Roosevelt reservoir that year held 160 million.) If the dam is built with sluice gates, most of the contained silt can be sluiced out at intervals—say once a year—but at a loss of water. For preventing erosion, a good growth of grass or forest is quite effective. Checks of brush and rock in the arroyos or small tributary channels and mattresses at sharp bends in the channel have proved effective on the Zuni watershed.[K11-1]

Filter walls and those of sedimentation basins should be kept clean, but scrubbing concrete walls is hard work. Why not line these with a dense, non-porous glazed material such as porcelain tile? This would facilitate more thorough cleaning and reduce the amount of labor and the time the basins are out of service. Wash water troughs might better be made of structural aluminum, monel metal or some of the rustless steels than of plain structural steel.[AA12-6]

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To find an indicated reference, find the given letter and bold-face number at the left of the column, and the light-face number (following the dash) immediately below this. The bold-face number indicates the month of issue of Public Works in which the article was listed, which is generally the current but may be a previous one.

c, Indicats construction article; n, note or short article; t, technical article.

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3. Discussion of Papers on the Mechanics of Chlorination. By Chas. E. Trowbridge, pp. 1,621-1,622.
4. Review of the Status of the Ammonia-Chlorine Process. By Marsden C. Smith, pp. 1,623-1,630.
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8. *t.* Discussion of Papers on Orthotolidine Test. By C. A. Holmquist, pp, 1,663-1,666.
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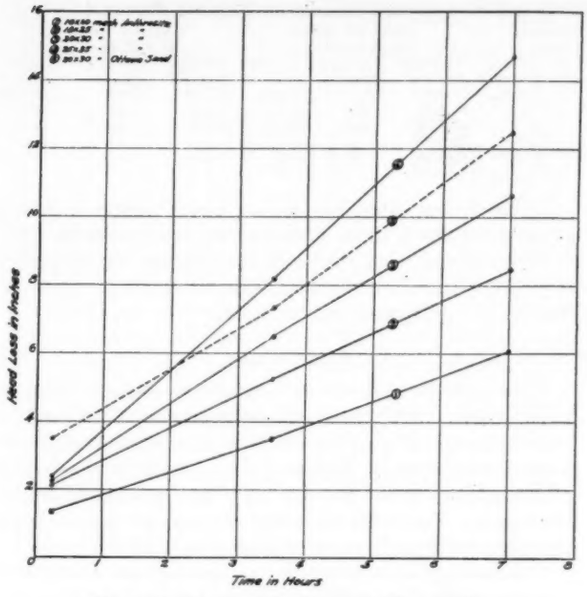

FIG. 2—Head losses of the several filter media

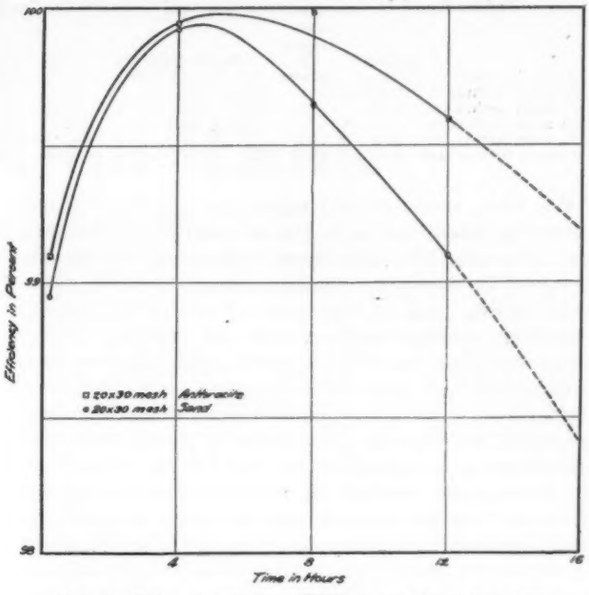

FIG. 3—Relation between efficiency and duration of run

Comparative Bacterial Efficiencies of Anthracite and Sand Filters

By H. G. Turner, G. H. Young and R. R. Cleland

Anthracite filter specialist, Research assistant, Pennsylvania State College and Sanitary engineer, Pennsylvania State College, respectively.

PREVIOUS work by this laboratory has shown qualitatively that fine anthracite used as a filter medium is effective in the reduction of bacteria. This was to be expected from consideration of its physical nature. Anthracite is a tough, hard, natural carbon having a conchoidal fracture, which results in sharp-edged, angular particles giving a higher percentage of void space than the equivalent size of sand when placed in a filter bed. Additional studies conducted in the Anthracite Institute laboratories have shown that fine anthracite is more effective than sand for the removal of turbid matter.

Although it is now generally accepted that the removal of bacteria from coagulated water parallels turbidity removal, the question of how efficiently anthracite will reduce the bacterial concentration of an applied water has occasionally been raised. This study was undertaken, therefore, to enable the above question to be answered *quantitatively* and conclusively.

It is generally recognized that the efficiency of bacteria removal is not a function of the filtering material alone. Proper plant design, with adequate backwashing facilities, is definitely a contributing factor to filter efficiency. In addition, extreme over-loading of any filter, with the accompanying long filter runs and high head-losses, can frequently result in "seeding," and in occasional "breaking-through" of floc particles containing millions of entrapped bacteria. Conditions such as these will give spasmodic effluent bacteria counts as great or even greater than the raw water count. Thus it is to be expected that filtration at a rate greatly exceeding the normal operating rate will result in "broken" filters and high effluent counts. These factors hold true not only in bacteria removal but in turbidity removal as well. But perhaps the greatest single determining factor in filter efficiency is adequate coagulation. An improperly coagulated water cannot be greatly improved by filtration, no matter what the filtering material may be.

Recognizing the importance of these contributing factors to efficient filter operation, we have carefully controlled our coagulation, filtration rates, water temperature, and experimental filter design. In all our experiments, filters which had been freshly backwashed were used, a 50 per cent expansion being maintained in all cases, and backwashing being continued sufficiently long to insure no bacteria remaining in the washed filters.

The results of our experiments show conclusively that the efficiency of bacteria removal closely parallels the efficiency of turbidity removal, and that anthracite is superior to sand with respect to removal of bacteria, as it was shown to be superior for the removal of suspended turbid matter. It is proposed that this observed superiority is largely due to the angularity of the anthracite particles and the accompanying better opportunity for anthracite to entrap floc particles containing the objectionable bacteria.

Although it is recognized that laboratory results cannot always be translated directly into terms of plant scale operation, yet with carefully controlled conditions, and with all of the error-introducing factors held approximately constant, data which are obtained by laboratory-scale experiments will serve as reliable criteria of the performance which can justifiably be expected on a plant-scale basis.

Tables I and II. Comparative Size and Uniformity Coefficient and Summarized Results on Bacteria Removal

Filter Material	Effective Size	Uniformity Coefficient	Depth of Bed Dry	Depth of Bed After Wash	After 15 Minutes B. Coli per cc. Average Applied	Average Effluent	Percent Removal	After 3½ Hours B. Coli per cc. Average Applied	Average Effluent	Percent Removal	After 7 Hours B. Coli per cc. Average Applied	Average Effluent	Percent Removal
10-20 mesh anthracite	0.96 mm	1.61	12 In.	13¾ In.	18,000	300	98.25%	27,500	2,100	92.45%	15,500	2,700	82.70%
18-25 mesh anthracite	0.74	1.21	12	14	29,500	210	99.40	34,500	275	99.25	5,800	225	96.01
20-30 mesh anthracite	0.61	1.21	12	14¼	27,000	200	99.30	47,500	100	99.75	65,000	60	99.91
25-35 mesh anthracite	0.52	1.21	12	14½	24,000	375	98.50	32,000	31	99.92	61,000	34	99.95
20-30 mesh Ottawa sand	0.61	1.21	12	12 7/10	24,500	220	99.20	35,500	90	99.70	37,000	170	99.45

We have, therefore, attempted to reproduce actual operating conditions in so far as operating techniques are concerned. The experimental filter used, which was designed by one of us, consists essentially of an overhead mixing and storage tank of about 10 gallons capacity, provided with an efficient stirring device. From this tank two 0.7 cm glass outlets lead to two vertical 1¾-inch glass filter tubes fitted with fine mesh copper wire screens to support the filter medium, and provided with 0.5 cm glass delivery tubing and constant-head rate-control devices. The effluent water from the filters passes through the rate controllers and thence to the waste drain. In addition, the tank and filters are fitted with upright glass loss-of-head gages by means of which the head loss can be measured directly in inches. The siphon delivery tubes are carefully calibrated to deliver at the standard 125 mgd rate over the range of head losses encountered in these experiments.

For convenience in handling and counting, it was decided to use water containing only Bacillus Escherichia Coli, which can readily be identified and counted by plating on purple lactose agar. Six agar slants containing pure cultures of Escherichia Coli were obtained from the Department of Bacteriology of Pennsylvania State College and fresh cultures of the bacteria were streaked on plain nutrient agar slants and incubated every 24 hours. The applied water was made up by transferring one loopful of bacteria from a 24-hour culture into 100 ml of water and inoculating the highly concentrated water sample thus prepared into 10 gallons of tap water.

The tap water carried an average of 0.2 ppm to 0.4 ppm of chlorine residual, and not only was sterile when inoculated, but often became so again twenty minutes after inoculation. This difficulty was overcome by dosing the charge with just sufficient sodium thiosulphate to destroy the chlorine residual, but which apparently had no ill effect upon the bacteria.

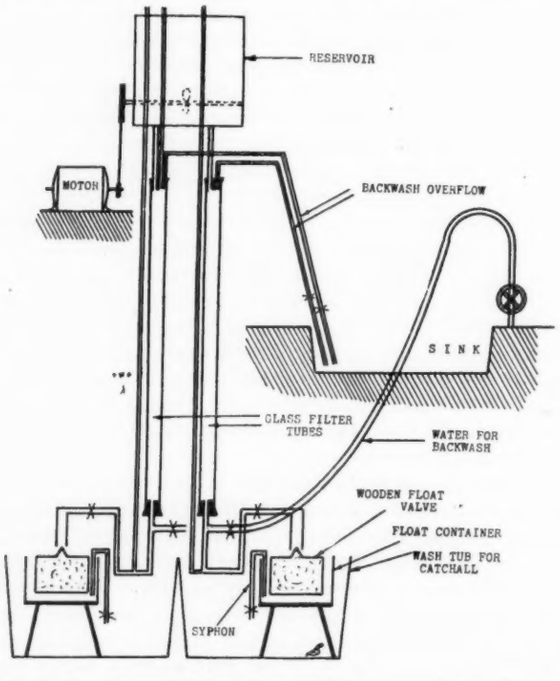

FIG. 1—Experimental filter plant used for comparing anthracite and sand filters.

Experimental

Four graded sizes of anthracite were studied: 10-20 mesh, 18-25 mesh, 20-30 mesh and 25-35 mesh, each in parallel with a fresh sample of screened 20-30 mesh Ottawa sand. Twelve inches depth of sand and of anthracite were run dry into the two tubes, backwashed for 5 minutes with 50% expansion and allowed to settle, with the expansion stated in Table 1.

The mixing tank was filled to capacity, the calculated amount of thiosulphate added, and stirred for 3 min.; then the inoculated water was added and stirred 3 min.; then 35 ml of a 5,000 ppm soda ash solution was added and stirred for 3 min., finally 35 ml of a 10,000 ppm alum solution was added and stirred for 15 min., and after settling for 5 min. the water was introduced to both filters.

After 15 min. operation, loss of head and water temperature of each filter were taken, and a 10 ml sample taken of the applied water and of the water in the filter delivery tubes of each filter and immediately plated. The biological techniques used throughout were those of the "Standard Methods." The medium used was Difco bacto purple lactose agar, with an additional 0.025 gram of brom-cresol purple per liter to give more distinctive acid reaction. Dilutions of 1:100 and 1:1,000 were used on raw water, and zero, 1:10 and 1:100 on effluents. All plates were made in duplicate and incubated for 24 hours at 37.5° C. Samples were taken similarly after 3½ and 7 hrs. Both filters were backwashed for 15 min. at 50% expansion just after and just before each run. Ten 7-hr. runs were made on each size of anthracite.

In addition, a study of comparative lengths of filter runs was made, using 20-30 mesh anthracite and 20-30 mesh sand. The filters were operated continuously until the maximum head-loss possible with the apparatus was obtained. Five such runs were made.

Results of all tests are given in the tables.

Discussion of Results

In general, our results show conclusively that the 20-30 mesh anthracite is consistently superior to the 20-30 mesh sand, not only giving appreciably higher bactericidal efficiency, but with lower loss of head. They confirm the general operating experience that the efficiency of bacteria removal varies with the degree of fineness of the anthracite; although the relation is not directly linear. As would be expected, the efficiency of the coarser sizes fell off with increasing time, the rate of change decreasing as successively finer material was used. Obviously, in selecting the size of material for a given installation, the operator must be governed by the maximum head attainable. Very coarse material would give relatively shortened filter runs, inasmuch as the period of service would have to be determined

(Continued on page 54)

A Digest of the Sewerage Literature of the Month giving the main features of all the important articles published.

The Digestion Tank

A **REGIONAL sewerage** scheme has been inaugurated in England covering 24½ sq. mi. of Birmingham and adjoining districts. One plant is already in operation which supersedes four small ones, receiving the sewage of 50,000 population with provision for rapid growth. The main sewers are designed for 6 times the dry-weather flow of 335,000 population, to which capacity the treatment plant can be enlarged. Noteworthy features of the plant are the utilization of digestion gas to provide all power required at the plant; the secondary tanks and aeration tanks are designed to balance the unequal dry-weather flow and ensure a uniform rate of discharge of treated effluent; and provision has been made to flocculate the colloidal matter entering the secondary sedimentation tanks by placing between these and the primary tanks a special pre-aeration tank supplied with the excess activated sludge from the aeration tank, with a view to securing more complete sedimentation in the secendary tanks and so reduce the work of the activated sludge tanks. The primary tanks have a capacity of 4 hrs. dry-weather flow, the secondary tanks 11½ hrs. flow, aeration tanks 12 hrs. flow, settling tanks 4 hrs. flow. The last are upward-flow with max. rate of 9 ft. per hr. The sludge is digested in 5 primary and 3 secondary tanks, the former with a retention period of 50 days and the latter 31 days. Eight half-acre sludge drying beds contain a layer of ashes with a top dressing of sand. The plant cost about $720,000; it was constructed mainly by direct labor.[D12-2]

Sludge digestion at Gravesend, England, is effected in two tanks, each 43 ft. diameter by 45 ft. deep, operated in series. Before entering each tank, the sludge is heated in a smaller tank by means of hot water radiators. "From the first year's working it is concluded that: (1) In deep digestion tanks all available gas can be extracted from strong domestic sewage in one tank, having a capacity of 9 gallons per head of population, when the sludge introduced has a water content of about 96%, the temperature of the digestion tank being about 65° F. (2) It is economical to carry out sludge digestion in two stages, no attempt being made in the second stage to collect the gas. (3) Deodorization of the sludge accompanies the extraction of gas from the sludge. (4) In both stages of sludge digestion it is very doubtful whether special stirring of the contents of the tank produces any beneficial results."[D1-2]

Drainability of digested sludge, as affected by degree of digestion and other conditions, especially gas production, was studied by Rudolfs and Heukelekian and they concluded that: "1—Drainability increased with increase in gas production until and shortly after the peak of gas formation had been reached. 2—Storage of digested sludge decreased the drainability. 3—The original nature of the sludge affected drainability. Certain trade wastes may greatly decrease the rate of draining. 4—Chemicals, such as alum, help drainability when the sludge is poorly digested or has been stored too long, but are ineffective when sludge is gasifying freely." In explanation of the last it is suggested that alum, copper sulphate and other chemicals increase drainability either by creating additional gas, such as carbon dioxide, or by coagulating small particles into larger ones, whereby gas films coalesce into larger bubbles and thus make the material more porous.[C1-4]

Plain aeration of sewage, without return of activated sludge, was tried in Indianapolis when activated sludge plant became of insufficient capacity to treat all the sewage in the regular way. In this way the space usually occupied in the aerator by the returned sludge is available for sewage. Also, sludge is removed only once in 8 hrs. and greater concentration of solids is obtained; but only 72% as much dry solids is removed from the sewage, a considerably larger percentage of which is ether-soluble. After more than a year's operation of the entire plant in this way, it was concluded that: "1—The plain aeration of sewage in the present plant removes a greater weight of solids and B. O. D. than can be removed by the same plant using the activated sludge process. 2—With the present plant, the unit cost of removal of solids and B. O. D. is lower using plain aeration. 3—The digestion of sludge from the plain aeration of sewage offers no difficulties, and the greater concentration of the sludge wasted has resulted in economy of digestion pit capacity." Aeration of the sewage before it enters the activated sludge aerator tanks was tried also, but the results did not appear to warrant its use.[C1-3]

Survival of B. Typhosus in activated sludge was studied by Ruchhoft in the North Side Treatment Works, Chicago. In an artificially infected aeration mixture, an initial 750,000 per c. c. of B. typhosus was reduced to 103,000 after 5½ hrs. aeration, and all but 5.8% of these were removed by the settling of the sludge —a total removal of 99.2%. Following the first three hours of aeration, 27% of the B. typhosus remained but there was practically no removal by allowing the sludge to settle.

"The survival of B. typhosus in stored activated sludge at 50° to 60° F. and 68° to 72° F. was investigated. Four strains of B. typhosus were used, including the Rawlins strain and three others freshly isolated from patients or carriers by the Chicago Health De-

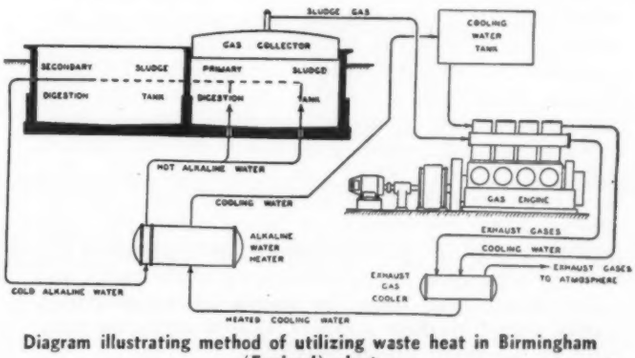

Diagram illustrating method of utilizing waste heat in Birmingham (England) plant.

partment laboratory. The results at 68° to 72° F. indicated that one of these strains died off very rapidly, two others survived from 8 to 10 days, while the Rawlins strain was re-isolated after 13 and 14 days. The Rawlins strain survived in Drainage Canal water for 10 days and a strain of B. paratyphosus A survived for 13 days.

"At 50° to 60° F. the Rawlins strain survived for a much longer period, thus indicating the great influence of temperature upon survival. At this temperature viable B. typhosus were re-isolated from the sludge after 83 days. Experiments with six sludges indicated that the time of aeration did not influence the percentage survival in the stored sludges.

"From this study it is concluded that wet activated sludge cannot be considered innocuous. At times it may be quite infectious. Caution should be observed when it is used as a fertilizer for truck gardens."[C1-2]

Garbage removal with the house sewage as believed feasible by Morris Cohn, who says: "The house maceration of waste food and the flushing of the material into the sewer is feasible and desirable in the home. . . . The ability of treatment works and of sewerage system to handle this new type flow appears to be reasonably well indicated." Existing plants—where they do exist—for disposing of sewage and those for disposing of garbage, are or soon will be inadequate in size and must be enlarged; and opportunity could then be taken to make a single plant of capacity sufficient for both purposes. Joint removal would require in each house kitchen a power-driven grinder capable of producing a pulp of uniform, flocculent nature (from which crockery, metal, etc., would be excluded), to be washed into the sewer with the sink water.[W12-5]

Garbage disposal mixed with sewage sludge is being tried experimentally at the sewage testing plant at the University of Illinois, using Imhoff tanks with a capacity of 80,000 g. p. d. each, one with domestic sewage only and the other with garbage added to it. The plant was operated for three months during the spring of 1934 for the purpose of tuning it up preparatory to beginning a two-year run which is now under way. It is proposed to try different combinations of garbage and sludge. Measures of the digestion of the mixtures will include: volatile solids in the digesting mixture; gas production, both volume and quality; temperature of digestion; and physical characteristics of the mixture, such as drainability, color, odor.[C1-7]

Treatment costs vary widely in Greenwich, Conn. In the four plants operated by that city in 1933, treating 118, 825, 171 and 231 mg respectively, the costs per mg were: For salaries, supervision and labor, $22.91, $8.24, $23.34 and $15.53 respectively; for power, $4.19, $0.65, $6.97 and $2.62; for repairs, supplies and miscellaneous, $5.02, $2.49, $8.23 and $4.60; for laboratory supplies, 28c, 4c, 19c and 14c; giving totals of $32.40, $11.42, $38.73 and $25.89 per mg, respectively. The costs per capita of connected population, however, were much more uniform, the total costs at the four stations being $1.27, $1.18, $1.66 and $1.50 respectively. The first plant consists of septic tanks and covered sludge drying beds; the second, of Imhoff tanks and open sludge beds; the third, of septic tanks to which the sewage is pumped, sludge beds on top of the tanks, and glass covers over both; the fourth, of sedimentation tanks with Link-Belt scrapers, heated digestion tank, and glass-covered sludge beds.[C11-5]

Sewer rental charges at Traverse City, Mich., are 80c per M for the first 3,000 cu. ft., 40c for the next 10,000, 20c for the next 10,000, and 10c for all over 23,000 cu. ft.; minimum charge $2.00 per quarter, less 5% for prompt payment; based on water meter readings for the two winter quarters (to allow for lawn sprinkling). Residence charges seldom exceed the minimum. The annual revenue approximates $18,000—ample for maintenance and operation but not for bond interest and sinking funds, which are for the present provided for in the annual budget.[C11-9]

Bibliography

To find an indicated reference, find the given letter and bold-face number at the left of the column, and the light-face number (following the dash) immediately below this. The bold-face number indicates the month of issue of Public Works in which the article was listed, which is generally the current but may be a previous one.

c, Indicates construction article; *n*, note or short article; *t*, technical article.

C 1 — *Sewage Works Journal* — *November*

1. *t.* Bulking of Activated Sludge. By Dr. Jan Smit, pp. 1,041-1,053.
2. *t.* Longevity of Bacillus Typhosus in Sewage Sludge. By C. C. Ruchhoft, pp. 1,054-1,067.
3. Operation Experiments at the Indianapolis Activated Sludge Plant. By C. K. Calvert and Don E. Bloodgood, pp. 1,068-1,072.
4. *t.* Relation Between Drainability of Sludge and Degree of Digestion. By Willem Rudolfs and H. Heukelekian, pp. 1,073-1,081.
5. *t.* The Lipids of Sewage Sludge. By O. J. Knechtges, W. H. Peterson and F. M. Strong, pp. 1,082-1,093.
6. *t.* Effect of Chlorine Dosage upon the Percentage Reduction of B. Coli. By Willem Rudolfs, John Ziemba and H. W. Gehm, pp. 1,094-1,102.
7. Disposal of Garbage with Sewage Sludge. By H. E. Babbitt, pp. 1,103-1,108.
8. Sludge Dewatering—Sand Filters and Vacuum Filters. By Frank W. Jones, pp. 1,109-1,130.
9. Plant Operation. By W. L. Stevenson, pp. 1,131-1,138.
10. Activated Sludge Sewage Treatment Works, Harlem Valley State Hospital, Wingdale, N. Y. By Henry Ryon, pp. 1,139-1,151.
11. Operating Difficulties at the Fredonia Sewage Disposal Plant. By Thomas Heubi, pp. 1,152-1,158.
12. The Population Equivalent of Certain Industrial Wastes. By C. K. Calvert and Elliott H. Parks, pp. 1,159.

D 1 — *The Surveyor* — *November 23*

1. Sewage Works Construction on Low-Lying Ground, pp. 515-516.
2. Sludge Digestion Plant of the Gravesend Sewage Disposal Works. By Harry Jackson, pp. 523-524.

November 30

3. Progress in Sewage Purification. By J. H. Garner, pp. 537-538.
4. Some Aspects of Sewer Design. By A. S. Knolles, pp. 543-545.

December 7

5. Design and Construction of a Small Sewage Works. By H. C. Rowley, pp. 565-566.
6. Solution of Oxygen from Air Bubbles. Discussion, pp. 567-568.

December 14

7. Sewage Purification Practice in South Africa. By T. P. Francis, pp. 591-592.
8. Sewage Treatment at Bradford, pp. 599-600.

E 1 — *Engineering News-Record* — *December 6*

1. Putting Sewage Sludge Energy to Use.

December 20

2. Data from Akron, O., Sewage Plant, p. 792.

December 27

3. Digestion Rates of Mixed Sludges Shown by English Experiments, pp. 828-829.
4. Data from Rockford, Ill., Sewage Plant, p. 832.

H 1 — *Municipal Sanitation* — *December*

1. Sewage Problems of the Small Community. By F. C. Roberts, Jr., pp. 406-408.
2. Lime to Be Reclaimed at Winston-Salem Sewage Plant. By R. M. Rogers, p. 408.
3. Research in Sewage Treatment. By H. E. Babbitt, pp. 409-410.

M 1 — *Canadian Engineer* — *December 4*

1. Inflammable Liquids and Gases in Underground Structures. By James Smith, pp. 17-21.
2. Pollution of Grand River Investigated, pp. 22-24.

P 1 — *Public Works* — *December*

1. Chemical Treatment of Sewage, pp. 9-10.
2. A Year's Experience in Sewerage and Sanitation. By E. R. Howson, pp. 48, 50.
3. Sludge Digestion in an English Plant, p. 68.
4. Rapid Determination of Turbidity and Suspended Solids in Sewage, pp. 68-69.
5. *n.* Sewer Rentals in Bloomington, Ind., p. 69.

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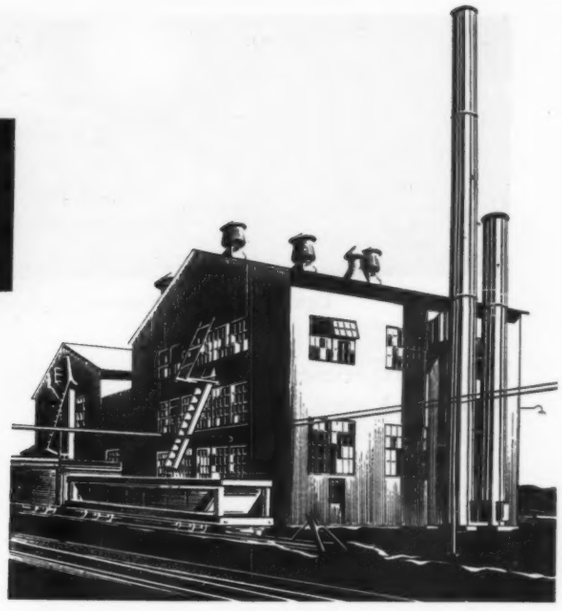

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A-191a

When you need special information—consult the *classified* READERS' SERVICE DEPT., pages 63-65.

Lighting results with mercury vapor lamps.

Detroit Experiments with Mercury Vapor Lamps

Experimental lighting on the lines of the Detroit Lighting Commission for a few blocks along 14th Street in that city, marks the first installation of mercury vapor lamps on street series circuit. Nine 400-watt Westinghouse High Intensity mercury vapor lamps in enclosing globes are mounted on 22-ft. poles staggered on 140-ft. spacings.

The lamps consume 400-watts and produce 14,000 lumens each. Thus, with a slight increase in wattage, the light output is more than doubled. Detroit's experimental street lighting installation is invoking considerable comment because of the sharper definition it affords pedestrians and auto owners. Note how sharply defined are the details of the car in the above view.

Norwalk, Conn. Gas and Electric Dept. Issues Special Report of Operations

The Gas and Electrical Department of Norwich, Conn., (population about 23,000) received $679,904 from consumers in the fiscal year 1933-1934, of which $192,935 was net profit, and $100,000 of this was turned over to the general fund of the city to lessen taxation. Of the balance, $25,344 was paid in interest on bonds and $15,000 of bonds were redeemed and $5,000 paid into the sinking fund.

In figuring the net profit, $95,831 was deducted for depreciation and $25,305 for interest. Of the total income, 19% was from gas and 81% for electricity.

At the beginning of this year the department issued a special report to the citizens of Norwich covering its operations for the past ten years. The report deals with the following subjects: Benefit to the City, Management, Sales, Expenses, Financial Condition, Benefit to the Individual Customer and Customer Cost. The report shows that the earnings for the five year period from May 1, 1924, to April 30, 1929 (Before the depression) of $893,446.06 and earnings for the five years, May 1, 1929, to April 30, 1934 (during depression) of $1,072,892.28. During the ten year period the Gas & Electric Department paid the city of Norwich $660,000 for its general use and $432,000 was used to reduce the outstanding indebtedness, from $958,000 to $526,000. Cash on hand amounts to $194,050.12 while current obligations consisting of customers deposits and accounts payable come to $38,000.

The plant property is listed as an asset on April 30, 1934 at $3,205,875, from which $1,232,691 is charged off for depreciation. In making up the balance sheet, $55,938 is entered as reserve for bad debts, $85,923 as sinking fund reserve, and $100,000 as reserve for payment to city; leaving as the city's equity in the plant $1,732,358.

Rates were reduced in 1925, revised in 1928 to the demand form which was decreased in 1929 and again in 1930. A further decrease by cash discounts of 5% was given in 1931 and in 1933 the discount was increased to 10%.

The average prices paid for electricity last year were: Commercial, .071 per kwh; residential, .058; power, .027; street lighting, .040; municipal departments, .030; other electrical corporations, .022. For gas the prices paid were: Commercial, .094 per 100 cu. ft.; residential, .159; house heating, .066; municipal, .161.

The New Brown Portable Potentiometer

The Brown Instrument Company, Philadelphia, Pa. announces a new Portable Potentiometer designed to enable Pyrometer users to check their Potentiometers, Millivoltmeters and Thermocouples quickly and accurately.

The combination of a step-switch and slide wire makes it possible to read the indicating scale to .01 millivolts over a total range of 71 millivolts. This step-switch and slide wire combination is equivalent to having a slide wire 109″ long. The indicating scale is 17″ long, making the smallest scale division (.05 mv) over 1/16″ in width.

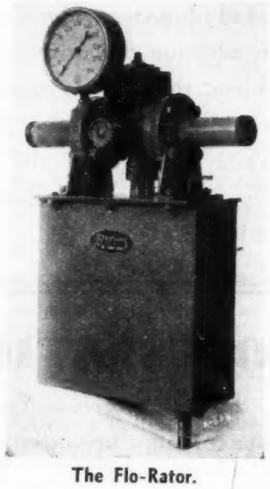
In addition to being simple in construction and extremely accurate, this new Brown Portable Potentiometer is small in size and light in weight. It is 9⅜″ wide x 10¼″ deep x 6¾″ high, and weighs only 12¾ lbs.

Flo-Rator Indicates Viscosity of Moving Liquid

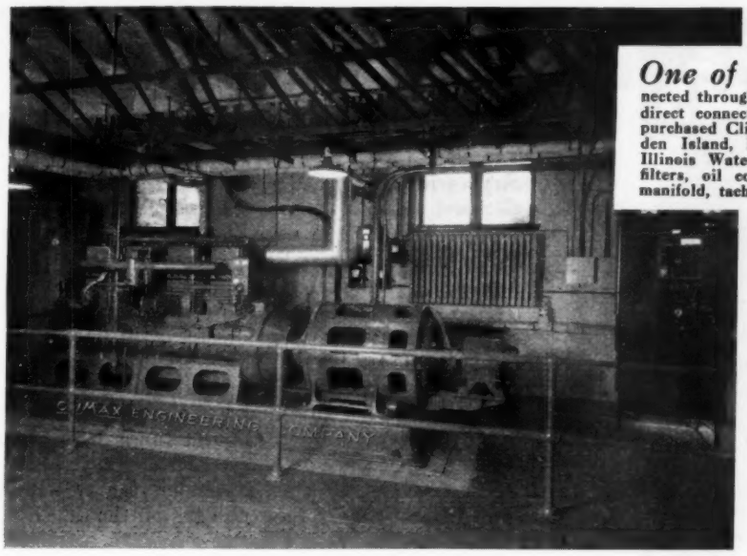
Viscosity is recognized by all modern standards as the measurement of rate of flow. Viscosity may be infinitely changing because of an uncontrolled heat transfer at the heaters. Where viscosity is a critical factor, the control should be consistently maintained and a constant indicator is most desirable. The Flo-rator is an instrument which constantly indicates the viscosity of a moving liquid.

In attempting to atomize fuel oil at viscosities higher than its critical rate of flow, the spray angle will become seriously affected and cause markedly inefficient combustion and drooling at the burners. On the other hand, should the oil become overheated and its viscosity lowered to approach its fire point, there enters the element of danger and inefficient combustion.

The Sterling Engine Company, 1270 Niagara St., Buffalo, N. Y., after an extensive period of development, offers the Florator, a modern and practical device for the constant indication of viscosity, or measured rate of flow, of liquids under varying conditions of pressure and temperature.



The Flo-Rator.



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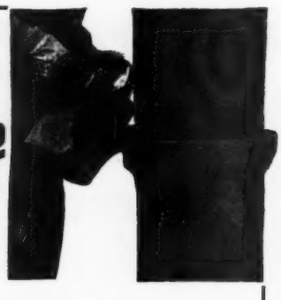

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Public Relief Work for Winter Weather

Suggestions From a Survey by Public Works

FROM the point of view of both the self-respect of the unemployed and the interest of the taxpayer, money given for work rendered is greatly to be preferred to that for which no return is asked. But a number of officials, municipal, county and state, seem to experience difficulty in finding work for this purpose, and especially work that can be done under winter conditions. Others, however, manage to keep as many occupied all winter as they can obtain funds for. As suggestions to the former, we have compiled a list of jobs reported to us as used last winter or proposed for the coming winter to keep their citizens off the dole.

Sewerage and Drainage

"Sewer construction seems to lend itself better to welfare labor than any other item of construction we have done," says George H. Sandenburgh, city engineer of Ann Arbor, Mich.; which city having built 17 miles of sewer with such labor, will build more sewers this winter, also a sewage treatment plant. Several other cities report building and repairing sanitary and storm sewers. Brookline, Mass., will encase with concrete a main sewer located in a large swamp to make it watertight; rebuild in a public street a sewer and surface water drain now located on private land; lower the outlet of and construct a covered concrete channel for the drainage of the municipal golf course, and construct a surface water drain for some private low land. Minneapolis will repair and rebuild sewers and storm drains in swamp areas. And a number of other cities report sewer work as among their proposed winter projects for welfare labor.

Improving stream beds is among the projects of several cities. Typical of these, the channel of a large brook has been relocated and its slopes are to be riprapped. River channels are to be cleaned and improved, and in some cases paved; in one case, to be straightened. Fresno County, Calif., will reclaim river channels and widen irrigation ditches. Minneapolis plans cleaning up and resetting its river front.

Street Work

By taking precautions which are now well understood, it is perfectly practicable to pave with concrete, tar and asphalt at below freezing temperatures, with perfectly satisfactory results. (See PUBLIC WORKS for this issue and for January and March, 1934.) In addition to regular work, several cities will do grading of streets, alleys, etc.; filling unopened streets in low lands, street widening, repairs to curbs and sidewalks; crushing old pavement base and miscellaneous concrete and operating city quarry to make aggregate for new work; paint white traffic lines, remove dead and dangerous trees; renovate street signs.

Under this head might also be included traffic surveys; and (for surveyors with non-technical assistants) making plots of unplotted property, surveying streets to determine distances between center lines of streets and angles at their intersections, checking and extending bench mark system, etc. Minneapolis will conduct a housing survey.

Public Grounds and Buildings

Several cities will do work of various kinds in parks, airports, municipal golf links, etc. Wichita, Kans., will

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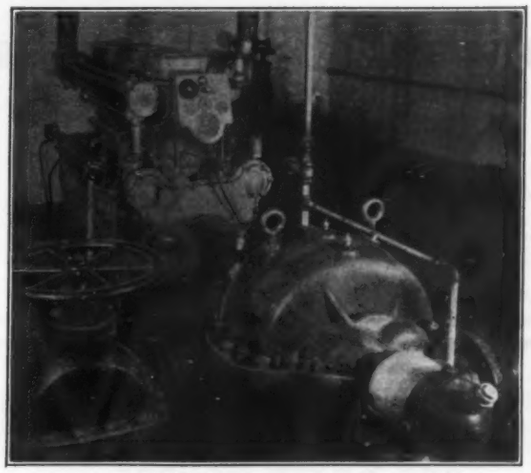

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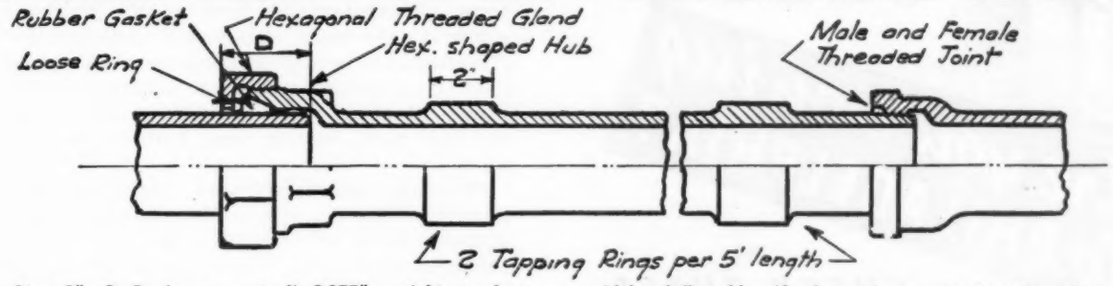

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remove dangerous trees from parks, build park shelters and picnic equipment, and build a municipal stadium. Other specified work includes cleaning up the edges of the fairways on the municipal golf course, fire prevention work in the "town forest" (water works water shed); but most refer generally to park "improvement" or "development." Raleigh, N. C., expects to employ men in airport development; Minneapolis on airport grading and improving.

Building, renovating and removing all kinds of public buildings is quite generally reported for welfare work. Among the new buildings are municipal garages, warehouse and stadium, and, in Raleigh, N. C., an ERA canning plant and mattress factory. Schools are to be "repaired and modernized," "rehabilitated," etc., by a number of cities (also by Fresno County, Calif.). Repairs, including painting, also are to be made to fire and police stations, shops, city halls, etc. Minneapolis will go the limit and wreck several "obsolete public structures," and Ann Arbor also.

State and County Work

Work by these larger political units is confined chiefly to that on the highways. This includes quarrying stone and gravel, and stock-piling same; surfacing with gravel; widening and grading; improving visibility at curves; cleaning up roadsides and side ditches; center striping; repairing bridges and constructing new ones; overhauling equipment; and snow removal. One county last winter operated a stone crusher fed by wheelbarrows, but found this so uneconomical that they will, this winter, use a drag-line in a gravel pit and haul to the crusher by truck.

Miscellaneous

Many jobs for the "white collar class" can be found in almost any city. One reports "indexing council proceedings." Surveys of various kinds to collect data concerning traffic, building improvements needed, house numbering, diseased trees or those needing pruning or dangerous to street users; violations of municipal ordinances of various kinds such as dangerous sidewalk defects; classifying, indexing, etc., in libraries; locating and listing structures on the highways such as telephone and light posts, awning posts, barbers' posts and other signs.

Obviously unnecessary work, just to give a man something to occupy his time, seems to us worse than useless. Knowing its uselessness, the worker does not benefit by enhanced self-respect, and the taxpayers supplying the funds are no better off. Plenty of work can be found in any municipality, we believe, which will be of value, even if the necessity for it did not seem sufficiently great to call for its performance at regular wages under normal conditions.

Anthracite Filters

(Continued from page 4)

by the quality of the effluent, since the accompanying head-loss would be low. Fine sizes, on the other hand, while giving longer filter runs, demand correspondingly greater available heads in order to maintain standard filtration rates, other factors being constant.

Consideration of the curves presented in Figure 3 will show that the sand reaches its maximum efficiency in a slightly shorter time than does the anthracite. It is our belief that this arises from the known difference in per cent of void space between the two filter beds. Anthracite, having as it does the greater percentage void space, will ordinarily require a slightly longer time to

attain its maximum efficiency. Reference to Table 4 will show, however, that over any given time interval the anthracite was at least equivalent in efficiency, if not actually superior, to sand. These results confirm the observations originally made on the seven-hour runs, and summarized in Table 2.

TABLE 3. Comparative Loss of Head on Twelve-Hour Continuous Runs

Filter Material	*Average Loss of Head in Inches*			
	After 15 Min.	*After 4 Hrs.*	*After 8 Hrs.*	*After 12 Hrs.*
20-30 mesh anthracite	2-3/8"	8-3/4"	20-3/10"	32-3/8"
20-30 mesh Ottawa sand	3-1/8"	10-1/2"	25-3/4"	40-1/2"

TABLE 4—Summarized Efficiency of 20-30 Mesh Sand and Anthracite for Twelve Hour Runs

	Bacteria	20-30 *Mesh Ottawa Sand*		20-30 *Mesh Anthracite*	
Time Interval	*Average Applied*	*Average Effluent*	*Average P. C. Removal*	*Average Effluent*	*Average P. C. Removal*
After 15 minutes	33,500	350	98.95%	325	99.10%
After 4 hours	42,500	30	99.93	25	99.95
After 8 hours	38,500	120	99.65	19	99.99
After 12 hours	44,500	400	99.10	160	99.60
		Average Overall Efficiency 99.32%		Average Overall Efficiency 99.69%	

It is unfortunate that our experimental apparatus did not permit the filters to be operated continuously until an actual break-point, measured in terms of bacteria removal, had been reached. This, however, was impossible as there was not sufficient head available to maintain the 125 mgd filtration rate for longer than fourteen to sixteen hours. Our experimental results, therefore, indicate only a certain trend. The rate of change of efficiency for the 20-30 mesh anthracite is lower than that for the sand. Accordingly, it seems logical to conclude that a materially longer run would be obtained with anthracite than with sand, all other factors being equal. This conclusion is substantiated by actual operating experience at the Denver, Colorado, anthracite filter plant, and at others, where the average length of filter run is much greater than that ordinarily obtained with sand.

Summary

(1) We have shown experimentally that anthracite is superior to sand of the same effective size and uniformity coefficient, when used as a filter medium for the removal of bacteria from coagulated waters.

(2) It is proposed that this superiority is largely due to the angular shape of particles of the anthracite, in contrast to the rounded grains of sand.

(3) We have experimentally confirmed operating experience, to the effect that efficiency of bacteria removal varies with the degree of fineness of the filtering material.

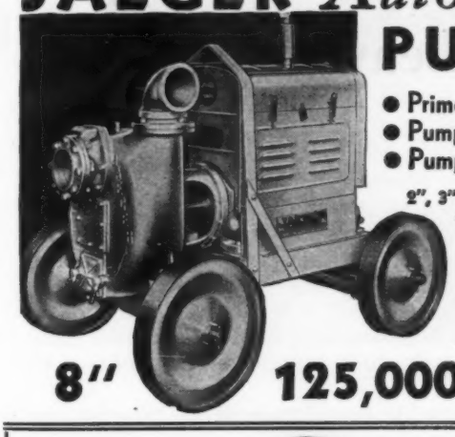
(4) Our experiments indicate that use of anthracite will result in appreciably longer filter runs when used for the removal of bacteria.

(5) Although anthracite requires a slightly longer time to reach its maximum efficiency, at no time is its efficiency lower than that of the equivalent size of sand.

Acknowledgments

The authors desire to acknowledge the cooperation of the Department of Grounds and Buildings, the Department of Bacteriology, and the Mineral Industries Experiment Station, all of the Pennsylvania State College.

JAEGER *Automatic* PUMPS



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Leaves From an Engineer's Diary

Wm. W. Reeder

I SEE by the papers that the President of the local Women's Club is speaking today on "What to Feed our Feathered Friends Through the Winter." This is the lady who called on me last August and demanded, with fire in her eyes, that something should be done to exterminate the starlings. They made night hideous with their chirping, and kept the sidewalks in a filthy condition. They should be slaughtered by gunfire or by poison.

Some ideas are like flannel underwear—to be changed with the seasons.

* * * *

FOURTEEN inches of snow this time. Just back in the office after thirty-six hours continuous work with the snow-plows opening the West Chester Pike to traffic; one of the most heavily traveled roads in the state. Were there any orchids waiting me? No! But there was a petition from a group of merchants in town complaining that we were discriminating by removing snow for their competitors.

* * * *

TALKED to Guy Swift today. He's the spellbinder of the current "reform" movement, and has been hurling verbal dead cats at our Public Works Department.

"Bill," he said, "I privately believe your department is run most efficiently, but you know we must have something to deplore."

* * * *

A MRS. SHORT from the Eleventh Ward called me a grafting politician today, because I wouldn't order her neighbors to construct cement sidewalks. She says it's all because she doesn't vote the right way. Gilbert and Sullivan once wrote a ditty explaining that "A policeman's lot is not a happy one." They should have been told about Public Works officials.

* * * *

FOUND one of our storm sewer inlets choked with about fifty very dead fish. We've found almost everything in our inlets from Christmas trees to baby coaches, but this is the first time it has been fish. Some Isaac Walton caught more than his friends were willing to clean. I'm sure I didn't put those fish there, but the female orator who lived in the nearest house seemed to think it was all my fault. And after she got through orating, I almost agreed with her.

* * * *

THIS morning I was standing at the end of a street we were cold patching. After the roller had passed, one good citizen rushed out and kicked a broken piece of curbing into the street. Then he complained that the roller had damaged his curb. Of course we fixed it, for that citizen is a very active member of the Good Government League, an organization which vociferously urges tax-cuts and economy in municipal administration.

* * * *

OUR street sweepers work fifteen hours a day, in two shifts, starting at 2:00 A.M. Today I found a lady throwing ashes in the street. She said she always did that so she could be sure that the sweeper cleaned the street during the night.

STARTED "surface treatment" of the highways today with asphalt and half-inch crushed stone. We always try to do this in August because we get the best results in real hot weather. I thought the property owners would be glad to see us working on their streets, but the only comment was,—"Guess it must be getting close to election time, I see they're fixin' the street."

* * * *

HAD the local papers print a notice last week requesting folks to refrain from burning dead leaves in the streets, as the heat "cokes" the asphalt and a hole is soon formed.

Tonight when I got home I found my wife had a fine big pile of leaves burning in front of our house.

* * * *

I MUST remember to buy some more aspirin now that they've handed me these ERA jobs. Six hundred paper hangers and insurance salesmen trying to lay 48″ storm sewers in a fourteen foot cut, and six feet of it rock. The boys are trying hard enough, but what a headache! Now I know what the resident engineer on the Tower of Babel was up against.

* * * *

WE Public Works officials should go straight to Heaven when we die,——we get our share of Purgatory holding down our job,—but I like it. Though salaries are never commensurate with the training and ability required, still I like it.

A former boss of mine once told me that any engineer who takes an official position with a municipality should have his sanity examined. Maybe he's right—but still I like it.

* * * *

Determination of Silver in Very Dilute Solutions

Recent interest in the oligodynamic properties of silver, that is, its bactericidal powers, has brought about the demand for an accurate analytical method for determining silver in very dilute solutions. Concentration of silver of the order of 0.02 to 0.20 milligram per liter are concerned.

The research associates on engineering uses of silver at the U. S. Bureau of Standards have devoted some attention to this problem. Feigl's rhodanine test, which has been shown by Feigl and others to be accurate for quantitative estimation of silver in concentrations as low as 1 part in 5,000,000, has been selected as a promising method. The accuracy of this method in extremely dilute solutions was found to be very seriously affected by the adsorption of silver on the walls of glass vessels used in the analytical procedure. The amount of adsorption on glass may be considerably modified by the type of glass used or by certain treatments of the glass surface prior to use in the analytical procedure. This adsorption appears to be far less serious if vessels of fused quartz are used. With proper regard for these adsorption phenomena it appears, from preliminary experiments, that the rhodanine colorimetric method for silver will be applicable to concentrations of the order of those encountered in the bactericidal uses of this metal.—*Journal of Franklin Institute.*

NEW CONSTRUCTION EQUIPMENT

Low Ground Pressure Features New Dragline:

Low ground pressure is the outstanding feature of the new P & H Model 750-LC dragline, designed primarily for work on irrigation and drainage jobs where soft ground is encountered.

The constant manipulation of mats commonly required to provide solid footing takes time and costs money by cutting heavily into the day's yardage. This fact moved P & H engineers to provide this machine with "mud shoes." Length of crawler has been increased to 15 feet 9¼ inches. Crawler shoes are 42 inches wide, resulting in a reduction of ground pressure to only 7.3 pounds per square inch—extremely low for a 2-yard machine.

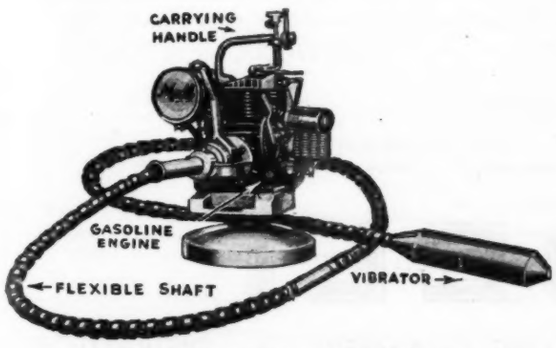
P & H with Mud Shoes

The exceptionally long corduroys are securely mounted on massive through axles. Traction is provided through a simplified chain drive with fully machined gears enclosed to protect them from dirt and obstructions.

In other respects the new 750-LC conforms to standard P & H design.

Concrete Vibrator Powered With Gas Engine:

A 2⅜-inch by 18-inch concrete vibrator with a flexible shaft powered by a 2-hp gas engine makes up the new concrete vibrator made by Mall Tool Co., 7740 South Chicago Avenue, Chicago, Illinois. By using this individual variable speed gasoline engine set, electric wires, generator sets and air compressors are eliminated. The vibrators are of the internal type and are immersed directly in the concrete. No special form work is necessary as there is no violent vibration of the forms.



The Mall Flexible Shaft Vibrator

Concrete vibration permits less water and lower sand content as well as larger portions of coarser aggregate giving more economical mixes. The shrinkage of concrete is materially reduced because of the higher percentage of coarse aggregate. Any depth of wall can be vibrated by adding suitable lengths of flexible shafting in units of 7 feet. Two additional lengths of flexible shafting which is ample for the average wall job, makes the shaft length with the vibrator and engine shaft a total of 28 feet.

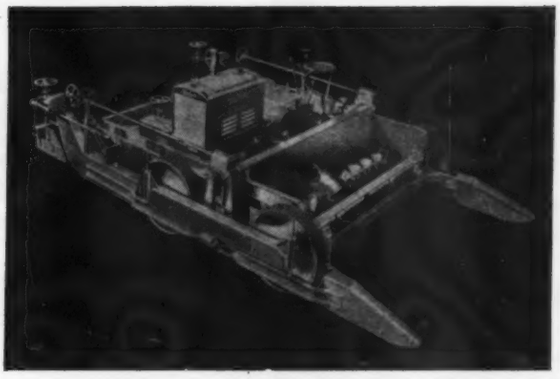
Jaeger "Self-Propelling" Black Top Paver:

This black top road builder, The Jaeger Machine Co., Columbus, Ohio, states, makes possible bituminous pavements having the smooth, fine riding qualities of concrete, without the use of road forms.

The paver is telescopic and adjustable for 9 to 15 ft. widths and handles 400 to 1,000 tons of material per day. Instead of the usual forms the machine has straight edge runners 18 ft. long which are movable forms and carry the screed only; all other weight of the machine and road material is carried on rubber tired wheels. The runners average out the subgrade and, since runners and screed float, wheels dropping into holes or irregularities of subgrade in no way affect the finish of the road.

No weight or traction is on the new road surface as runners and wheels operate on the old road or subgrade, and only the screed and blender screeds at rear touch the newly laid material. The four rubber tired wheels, operating on firm ground, will take the machine with loaded hopper up any grade with no spinning of wheels or tearing of new surface—an important advantage. Runners can be lifted in 2 seconds, by power, for maneuvering on job.

The screed is standard Jaeger-Lakewood oscillating type with saw tooth front edge, tiltable for compaction. It can be set for any specified crown and thickness of spread 1 inch to 6 inches and, if necessary, run to any grade wire or marker.



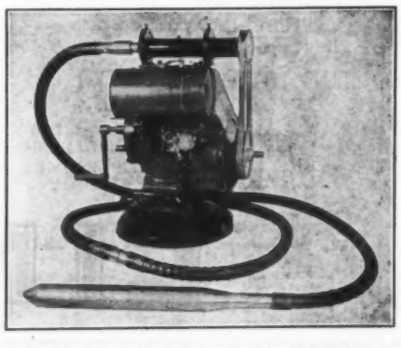
Jaeger Black Top Paver

Superior Concrete Vibrators:

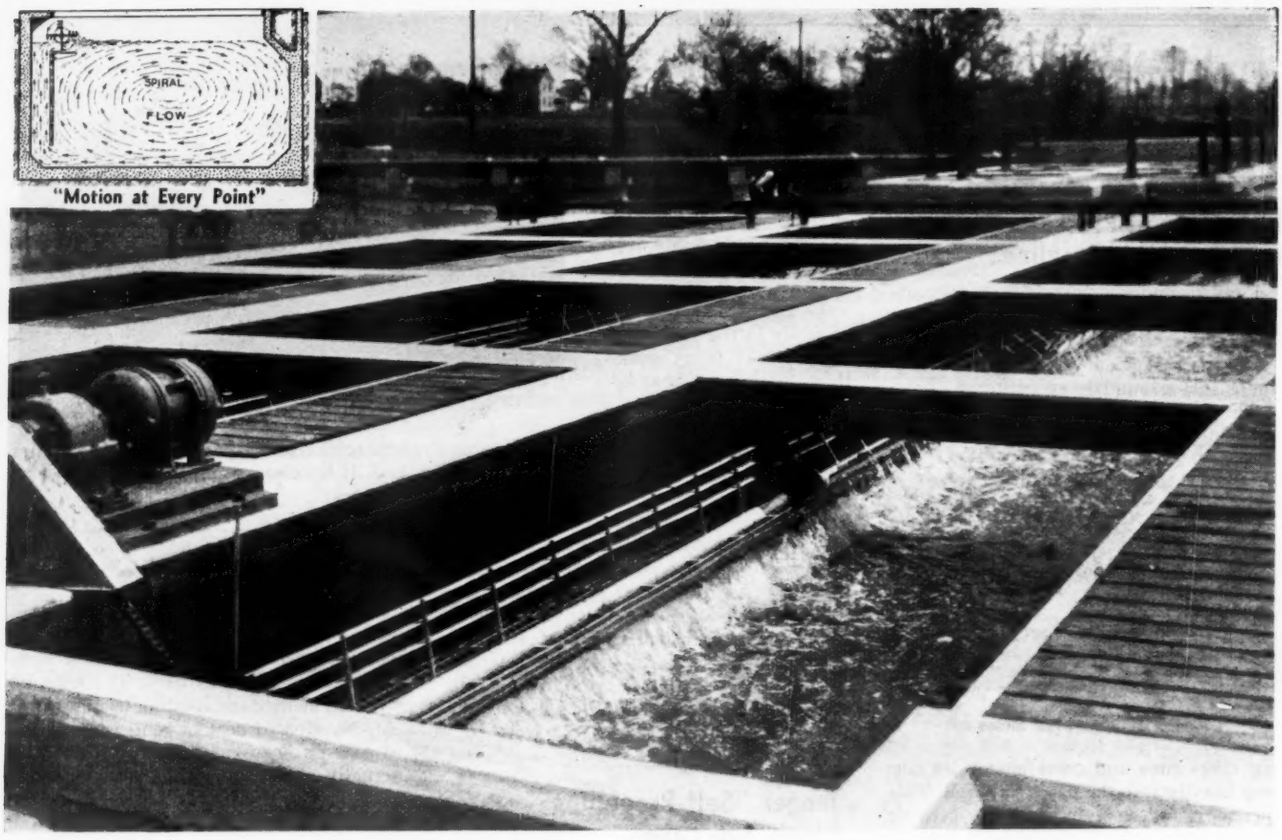
The many advantages in vibration of mass concrete include: production costs decreased as much as 60% as compared with old methods of spading or puddling; consumption of cement reduced; and use of coarser aggregate made possible, with actually a stronger and denser concrete resulting. Vibration also tends to eliminate honeycombing, air bubbles and scaly surfaces, increases the bond between concrete and steel reinforcing and, allows the placement of drier mixes of low workability.

Two new concrete vibrators have been announced by Superior Construction Equipment Co., 1836 So. Kostner Ave., Chicago, Ill. These are both driven by gasoline engines but electric motors may be furnished if desired. The new Model M-1, as illustrated, is provided with 2 h.p. Lauson engine, mounted on free swiveling base, with 2⅜" diameter vibrator. The Model M-2 has a 4 h.p. Lauson engine and wheelbarrow mounting with 12"x3.50 single pneumatic tire, and 3½" diameter vibrator.

Both vibrators are self contained, fully enclosed, and give from 3800 to 4000 pulsations per minute. The rotors are carried by ball bearings and driven from the engine by flexible steel shafts, encased in moulded rubber hose with internal spiral steel bearing and full external steel armor.



A new concrete vibrator by Superior



Air Costs Money

. . . when applied under pressure at the bottom of an activated sludge tank; money to install the motor and blower or compressor, the air piping and diffuser plates; and additional expense continuously thereafter to operate. The cost of delivering filtered air against hydrostatic pressure at the bottom of a deep tank, keeping the diffusers clean, and maintaining the motor-driven equipment, is considerable.

The greater part of the air so expensively delivered is used for mixing, rather than for supplying oxygen. Mixing of the air and returned activated sludge with the incoming sewage is very important—just as important as supplying oxygen. The more thorough the mixing, the less oxygen required, and the better the result. But more thorough mixing can be effected at less cost by other means than injecting air. We believe the Link-Belt STRAIGHTLINE Aerator is the best means available for this purpose.

The STRAIGHTLINE Aerator combines agitation with a spiral motion, the latter bringing every drop of the sewage to the revolving blades several times, as it flows through the tank, thus effecting complete mixing, besides spraying and agitating the surface so that every drop is given an opportunity to absorb all the oxygen it demands from the atmosphere. Experience has demonstrated that oxygen absorption so provided, meets all requirements of activation.

The STRAIGHTLINE Aerator is perhaps the simplest piece of mechanism used in modern sewage treatment—only a shaft carrying blades and revolved by a motor, the shaft and its roller bearings being located well above the sewage. No skilled mechanic is required to operate it, and there is practically nothing to get out of order or to clog. There are no "dead" spots in the tank where sludge can collect—all the tank contents are continuously in motion, at a velocity that can be varied to meet conditions. It is really simpler to operate than a plain digestion tank.

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Water and Water Purification Apparatus

Electric Vibratory Dry Feeder:

Syntron Company, specialists in the manufacture of pulsating electro-magnetic vibrators and hammers, has developed a purely vibratory dry feeder machine, designed to provide a dependable, constant flow of dry material, such as is essential for treating drinking water with lime, carbon, alum, etc.

The equipment as illustrated consists of a vibrating feeder trough fed from a vibrated hopper.

The volume of flow of the material through the feeder trough is regulated electrically by a dial rheostat controlling the current input to the feeder vibrator. Once set the volume flow remains constant.

A steady, smooth discharge from the hopper into the feeder is insured by a small vibrator on the hopper that keeps the contents agitated to prevent arching and sticking.

The capacity can be varied to feed

Syntron Vibratory Feeder

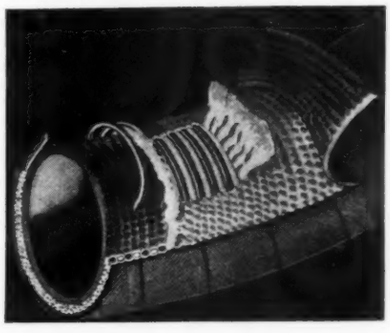
from 2 ounces to 2000 pounds per hour and the current required for operation is less than 200 watts per hour. A low hum is the only indication of the machine in operation.

The major advantage of this vibratory type of feeder, in addition to its electrical control and constant volume of flow, is the absence of all wearing parts, such as motors, gears, bearings, connecting rods, slide valves, etc., no lubrication being required as all movement is through flat leaf springs and live rubber.

Full catalog information can be secured by writing the Syntron Company, 400 North Lexington Ave., Pittsburgh, Pa.

Lighter, Stronger and More Flexible Suction Hose:

It is no longer necessary to use a heavy, cumbersome hose for suction purposes. A new type of construction which has a woven tubular re-enforcement of strong cabled cotton cords and wire, making a very strong but light hose which will not collapse, has recently been developed by the Electric Hose and Rub-



Delmar Suction Hose

ber Company, Wilmington, Delaware.

This new hose has a smooth lining of specially compounded rubber which has long life and offers minimum frictional resistence to flow.

Another advantage of this new hose is that if it should accidentally be crushed, it can be quickly restored to shape by use of a vise or mallet. It can be easily connected to standard couplings on the job, and does not require soft ends on the hose.

This new hose, known as Delmar Suction Hose, is made in all sizes up to 4″ inside diameter, and can be used in practically all types of suction hose service.

Clip Type Gate Valve:

A clip type gate valve with several new features has been added to the extensive line of the Reading-Pratt & Cady Company, Inc., Bridgeport, Conn. This valve has a round bonnet and, therefore, differs essentially from the conventional style of clip gate valves. Round bonnet construction permits the use of a male and female joint with asbestos gasket assuring tightness.

A full U-Bolt is used to hold the bonnet joint tight. When the nuts on these bolts are tightened, pressure is equalized on both sides, a difficult operation with independent bolt styles. Three sets of guides on the body and two solid eye lugs on the bonnet hold the U-Bolt and eliminate possibility of slipping.

RPC Clip Type Gate Valve.

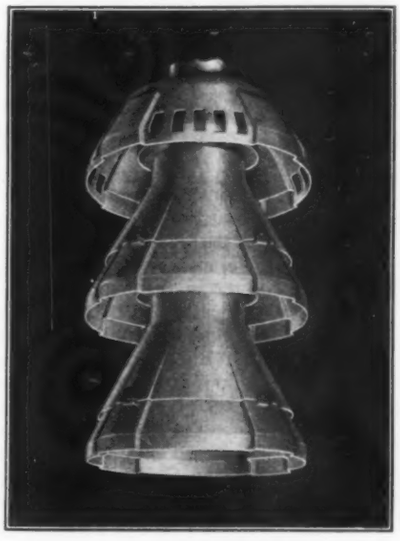
Among the internal features are the full thickness I-Beam cast wedge which brings sturdiness to the valve seat and permits the use of full size body guides to assure correct seating. A horseshoe connection is used to assemble the spindle and wedge. This provides greater strength and greater lifting surface than the usual tee slot connection.

Multi-Cone Aerators:

Efficient aeration of water for removal or reduction of dissolved gases, for the oxidation of iron and manganese, for the addition of oxygen, and as an aid in odor removal is possible with the new multi-cone aerator of the International Filter Co., Chicago, Ill. Advantages are that a low operating head is required and only a space is needed for installation. Static head for operation is only four feet.

Because of the small space required, this aerator is especially adapted to installation designed to increase capacity or improve operation of existing plants. Considerable flexibility allows effective aeration over a wide capacity range.

A special bulletin describing this unit will be sent on request.



Multi-Cone Aerator for water treatment

Engineering News Items

New York State Sewage Works Association:

The Seventh Annual Meeting of the New York State Sewage Works Association will be held in New York City at the Hotel McAlpin on January 15, 1935. The Program Committee and William Raisch, chairman of the Committee on Local Arrangements, have arranged the program, as follows:

H. H. Hendon of Birmingham, Alabama, will describe the Shades Valley chemical precipitation plant, and J. S. Pecker of Philadelphia, will have a paper on Centrifugal Dewatering of Sludge. Wellington Donaldson will give a paper on Sewage Plant Laboratories, and Dr. Isaacs of Columbia University, will describe the new Colorimetric Test for Dissolved Oxygen.

John R. Downes of Plainfield, N. J. will discuss some of the unique features of the joint Plainfield, North Plainfield and Dunellen works, illustrated with lantern slides and moving pictures, which will be more or less in preparation for the post convention trip on Wednesday.

At the business meeting, there will be a special report of the Research Committee on the work that has been initiated by that committee during the past year.

In the evening the association will join the Sanitary Engineering Division of the American Society of Civil Engineers at the annual dinner at the Hotel McAlpin.

Wednesday, January 16th, through the courtesy of the Industrial Associates and John R. Downes of Plainfield, bus transportation and a buffet luncheon will be furnished for the inspection trip to the Plainfield, N. J., sewage treatment works.

National Paving Brick Association

The Twenty-ninth Annual Meeting of the National Paving Brick Association will be held at Indianapolis, Indiana, February 6, 7 and 8, 1935 at the Claypool Hotel. The sessions on February 7 and 8 will be open to the general public. There will be descriptions of recently constructed brick street and highway paving and resurfacing projects and a discussion of recent developments in paving brick production and utilization. Such topics as the de-airing process of manufacture, the use of the vertical fiber lug brick, and the surface removal method of filler application will be included. There will be a report from the Director of the Research Bureau maintained by the National Paving Brick Association at the Ohio State University Experiment Station. The relationship of brick pavement construction and relaying to unemployment relief and the increasing utilization of brick for resurfacing worn pavements and bases will be a prominent feature of the program.

O. W. Renkert, Metropolitan Paving Brick Company, is President, and George F. Schlesinger, formerly Director of Highways in Ohio, is Chief Engineer and Secretary of the National Paving Brick Association. There are six member companies manufacturing paving brick with plants located in the State of Indiana.

Southeastern Section, AWWA:

The Southeastern Section of the American Water Works Association will meet in Birmingham, Ala., April 2 to 4, 1935. W. H. Weir, Room 135, State Capitol Bldg., Atlanta, Ga., is secretary of the section.

New Jersey Sewage Works Association:

The 20th Annual meeting of the New Jersey Sewage Works Association will be held at the Stacy-Trent Hotel, Trenton, N. J., on March 21st and 22nd, 1935. Paul Molitor, Jr., Morristown, N. J., is treasurer.

Associated General Contractors:

The sixteenth Annual convention of the AGC will be held in Washington, D. C., January 28-30. The chief topic of discussion will be the need of a well-rounded and sound program of public works.

Coming A.W.W.A. Section Meetings

March 27-29, 1935—Canadian Section—Hotel London, London, Ont., Canada. Secretary, A. E. Berry, Ontario Department of Health, Parliament Bldgs., Toronto, Ont., Canada.

May 6-10, 1935—Annual Convention of American Water Works Association—Hotel Netherland Plaza, Cincinnati, O. Secretary, B. C. Little, 29 W. 39th St., New York, N. Y.

Business Personals:

C. Parker Holt has been made executive vice-president of the Caterpillar Tractor Co., and Thomas J. Conner is the new vice-president in charge of manufacturing. He is also a director of the company. Robert F. McCloskey has been director and vice-president in charge of the plant at Blawnox, Pa.

Chester H. Lehman, formerly secretary of the Blaw-Knox Co., has been appointed vice-president in charge of sales. H. B. Loxterman succeeds Mr. Lehman as secretary and also becomes a director.

A. W. Scarratt has been made chief engineer of the International Harvester Co., in charge of all the company's automotive engineering activities. W. R. Reese succeeds Mr. Scarratt as chief engineer of motor truck engineering.

American Road Builders' Association

William P. McDonald, president of a large construction company in New York City that bears his name, is expected to succeed Captain H. C. Whitehurst, Director of Highways of the District of Columbia, as President of the American Road Builders' Association. The other nominees are:

Vice Presidents—Paul B. Reinhold of Pittsburgh, Pa.; George Pou of Raleigh, N. C.; Grover C. Dillman of Grand Rapids, Mich.; and Stanley Abel of Taft, Calif.

Treasurer—James H. MacDonald of New Haven, Conn.

Directors for term ending 1938—Edward Costigan of Washington, D. C.; Arthur W. Dean of Boston, Mass.; Frederick Hoitt of Boston, Mass.; Charles T. Hvass of New York City; T. S. O'Connell of Phoenix, Ariz.; Thomas S. Stephenson of Altoona, Pa.; and Charles M. Upham of Washington, D. C.,

Officers also have been nominated for the City and County Officials' Divisions of the organization. In the City Officials' Division, the nominations follow:

President—Dudley T. Corning of Philadelphia, Pa.

Vice-Presidents—Nathan L. Smith of Baltimore, Md.; W. E. Sheddan of Jacksonville, Fla.; Grover C. Dillman of Grand Rapids, Mich.; and Harvey W. Hincks of Pasadena, Calif.

Directors for term ending 1938—J. W. A. Bollong of Seattle, Wash.; George Cobb of Baltimore, Md.; W. E. A. Doherty of Philadelphia, Pa.; Maurice O. Eldridge of Washington, D. C.; D. L. Erickson of Lincoln, Neb.; and Henry A. Yancey of Petersburg, Va.

Nominations for officers in the County Officials' Division follow:

President — George C. Wright of Rochester, N. Y.

Vice-Presidents—J. A. Bromley of Annapolis, Md.; C. C. Thacker of Nashville, Tenn.; J. W. Mavity of Newton, Kans.; and Stanley Abel of Taft, Calif.

Directors for term ending 1938—Lloyd Bowman of Santa Cruz, Calif.; J. T. Bullen of Shreveport, La.; Ben T. Collier of Clarksdale, Miss.; C. H. Overman of Bagdad, Fla.; A. P. Shaw of Wilmington, Dela.; W. O. Washington of Brownsville, Texas; and Allan Williams of Ionia, Mich.

The tentative program of the meeting, which will be held at the Willard Hotel, Jan. 22-25, is:

Tuesday, January 22

2:00 P. M.—Opening Session
Review of Highway Program
Federal Legislation
Continuation of Highway Program

Wednesday, January 23

10:00 A. M.—Highway Contractors
2:00 P. M.—Highway Contractors
County Highway Officials' Session
City Officials' Session
4:00 P. M.—Pan American Session

Thursday, January 24

10:00 A. M.—Special Committees
2:00 P. M.—General Session
Conservation of Highway Revenues
7:30 P. M.—Road Builders' Banquet

Readers' Service Department

Any of this Industrial Literature will be sent FREE upon request

Construction Materials and Equipment

Asphalt Heaters

9. Illustrated manual No. 11 describes "Hotstuf," the master oil burning heater. The only heater with patented elevated melting chamber for Asphalt, Tar and all bitumens used in road and street construction and maintenance roofing, water proofing, pipe coating, etc. Mohawk Asphalt Heater Co., Frankfort, N. Y.

Bituminous Mixers: Locking Device

11. Time locking device for bituminous mixers, all mechanical, is described and illustrated in bulletin TL10 just prepared by Hetherington & Berner, 701 Kentucky Ave., Indianapolis, Ind. Adaptable to any plant.

Chip Spreader

13. Full information concerning their new chip spreader for trucks will be sent promptly by Good Roads Machinery Co., Kennett Square, Pa.

Concrete

15. "Watertight Concrete" is a new booklet presenting sound concrete practice in simple, non-technical language. Contains photographs and diagrams that are easy to understand. Just issued by International Cement Corp., Room 2200, 342 Madison Ave., New York, N. Y.

16. "Winter Construction" isn't a lot of sales promotion copy but is a new booklet full of helpful down-to-earth suggestions on how to save costs in cold weather construction. Write for free copy now. International Cement Corp., 342 Madison Ave., New York. N Y.

Concrete Accelerators

30. "How to Cure Concrete," a forty-seven page manual published by the Dow Chemical Company, Midland, Michigan, treats fully subjects suggested by title.

31. "Curing Concrete Roads with Solvay Calcium Chloride," 30 page booklet. Comprehensive. Contains tables, illustrations, suggestions for testing devices. Covers the subject in considerable detail. Solvay Sales Corp., 61 Broadway, N. Y. C.

35. A new, leather-bound manual giving complete details for curing concrete in all kinds of weather with calcium chloride has just been issued by Columbia Alkali Corp., Barberton, Ohio. Pocket size, flexible, contains 54 pages of text and 32 pages ruled for notes. Also contains many useful tables.

36. "Wyandotte Calcium Chloride and its use in Portland Cement Concrete," a booklet covering the subject of curing concrete pavements, structures, etc., giving complete specifications for surface and integral curing. Published by the Michigan Alkali Co., 60 East 42 St., New York, N. Y.

Concrete Mixer

44. Concrete Mixers, both Tilting and Non-Tilting types, from 3½s to 84s size, The Jaeger Machine Company, Columbus, Ohio.

Concrete, Vibrated

50. Data on methods and equipment for, and the results obtained from the use of, vibrating equipment on thin walls, pavements, culverts, bridges, floors and other concrete construction. Munsell Concrete Vibrators, Teaneck, N. J.

Crushers

57. Up-to-date information on Stone Crushers, Stone Spreaders, Unloaders, Drags and other contractors' equipment from the Gallon Iron Works & Mfg. Co., E. Jeffry Mfg. Co., Columbus, Ohio.

Culverts

60. "In diameters up to 10 feet and larger . . ." just issued by the Armco Culvert Mfrs. Assn., tells a good deal about drainage problems and their solution. 32 pages about drainage and multi-plate culverts.

Explosives

74. "Use of Explosives for Settling Highway Fills." A new booklet which fully explains by diagrams and charts the three methods developed after many tests by the Du Pont engineers, which singly or in combination will quickly and efficiently do your job. Just issued by E. I. Du Pont de Nemours & Co., Inc., Explosives Dept., Wilmington, Del.

Floor Construction

75. "Heavy-Duty Floor Construction" is a new data book presenting all essential points in non-technical language. Illustrated with pictures specially taken for this purpose. Sent free to those interested by International Cement Corp., Room 2200, 342 Madison Ave., New York, N. Y.

Graders

76. Latest information about Gallon Motor Patrol Graders, Road Maintainers and Leaning Wheel Graders with hydraulic control is contained in a new series of illustrated catalogs, Nos. 125, 130, 135 just issued by the Gallon Iron Works & Mfg. Co., care of The Jeffrey Mfg. Co., Columbus, Ohio.

Loaders and Unloaders

97. Portable Loaders and Unloaders. Folders: Nos. 1248, 1298 and 1074 cover Belt Conveyors with channel iron and truss types of framework; No. 1076, Portable Bucket elevators for different classes of work; and No. 1256, the "Grizzly" Crawler Loader for heavy work and large capacities. Link-Belt Company, Philadelphia.

100. Materials Handling and Positive Power Transmission Equipment, giving technical data, list prices and illustrations of this machinery. Link-Belt Co., Chicago, Ill. General Catalog No. 500.

Motor Trucks

105. Full information about their complete line of motor trucks, all powered by six-cylinder "truck-built" engines of uniform valve-in-head design, will be sent promptly. General Motors Truck Co., Pontiac, Mich.

106. "Trucks for Public Utilities," is a new illustrated booklet just issued by the International Harvester Co., 606 So. Michigan Ave., Chicago. Covers uses, types, special equipment, bodies and specifications. Sent free on request.

Paving Materials

108. "Emulsified Asphalts" is a 56-page manual covering Penetration Type Construction, Road and Plant Mixes Pavements, Surface Treatments and Maintenance Methods. Includes 58 illustrations. Sent free by Headley Asphalt Division, Sinclair Refining Co., P. O. Box 73, Marcus Hook, Penna.

226. "Asphalt Surfacing Materials for Low-Cost Roads" is a handy 28-page booklet illustrating the many types of road surfaces which can be constructed with Texaco asphalt materials. Well illustrated and contains tables of amounts of stone, sand and asphalt required. Sent promptly by the Texaco Company, 135 East 42nd St., New York, N. Y.

109. A 36-page booklet with 66 illustrations has just been issued by the Barrett Co., giving full information regarding the making, laying and maintaining of "Tarvia-lithic," the ready-to-lay pavement.

111. "Tarvia Double Seal Pavements." Shows, step by step, the construction of a Tarvia pavement. 24 pages. The Barrett Company, 40 Rector Street, New York.

(Continued on following page)

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READERS' SERVICE DEPARTMENT

(Continued from previous page)

112. Complete directions for surface Cut Back Asphalt are contained in a 36 treatment and bituminous surfacing with page data book. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Protective Coating

118. KRODEPROOF, the ideal protective coating for all structural surfaces subject to corrosion or contact with water is described in an 8-page bulletin recently issued by Lewis Asphalt Engineering Co., 30 Church St., New York, N. Y.

Road Machinery

126. A new general reference catalog No. 1320 covering their entire line of equipment for every approved method of construction and maintenance has just been issued by Austin-Western Road Machinery Co., No. A-5, Aurora, Ill. Profusely illustrated with action pictures showing each type of machine out on the job.

127. "Road Machinery Illustrated." New illustrated bulletins on the motor rollers, three-wheel and tandem rollers, motor graders powered by Caterpillar, Twin City, Cletrac, McCormick-Deering and Fordson tractors, and straight and leaning wheel graders. Galion Iron Works & Mfg. Co., Galion, O.

Rollers

132. A 32-page book in four colors featuring a complete line of road rollers. 8¾ x 11, leatherette cover, numerous action pictures. Buffalo-Springfield Roller Co. of Springfield, Ohio.

133. 20-page pocket size booklet showing all types of Buffalo-Springfield motor rollers and scarifiers and their uses.

Sand and Gravel Washing Plants

140. Seventy-page catalog giving complete information regarding Sand and Gravel Washing Plants, stationary and portable. Those interested in such equipment should have a copy. Link-Belt Co., Chicago, Ill.

Shovels, Cranes and Excavators

145. The Austin Badger, a new, fully convertible ¾ yard crawler shovel, made by The Austin-Western Road Machinery Co., No. A5, Aurora, Ill., is fully described and illustrated in their Bulletin No. 1236.

146. Link-Belt Co., Chicago, Ill., has issued Book No. 1095, which describes and illustrates their complete line of Gasoline, Electric, or Diesel operated shovels, cranes and draglines, 910 S. Mich. Ave.

Soil Stabilization

150. Explicit instructions for testing soils and constructing and maintaining low-cost stabilized roads are contained in two excellent new booklets. No. 1 contains brief specifications for construction. No. 3 makes clear the procedure in sampling and calculating mixtures. Both are well illustrated with tables of useful information, charts and photographs. Just published by Solvay Sales Corp., 61 Broadway, New York, N. Y.

Street and Paving Construction

Asphalt Mixing Plants

204. A new illustrated bulletin No. M234 describing their asphalt mixers for bituminous paving mixtures of all kinds has just been issued by Hetherington & Berner, Inc., 701 Kentucky Ave., Indianapolis, Ind. Covers both steam-jacketed, steam operated; and hand operated types. Sent on request.

Distributors

206. Kinney distributors of from 600 to 1,700 gallon tank capacity with heating system and the Kinney jacketed pump having a capacity of over 400 gallons per minute are described in a new catalog just published by the Kinney Mfg. Co., 3533 Washington St., Boston, Mass.

Dust Control

209. "3000 men put back to work in a single county." A new folder just issued by the Solvay Sales Corp., 61 Broadway, New York City, outlining a road program which is a relief program. Sent promptly on request.

210. "How to Maintain Roads with Dowflake" is a new 58 page illustrated booklet of information on stabilized road construction. Includes specifications and several pages of reference tables from an engineer's notebook. Just issued by Dow Chemical Co., Midland, Mich.

211. "Principles of Road Soil Stabilization," a new booklet just issued by The Columbia Alkali Corporation, Barberton, Ohio. Gives a clear, concise picture of what road soil stabilization is and how it can be accomplished.

212. "Wyandotte Calcium Chloride Prevents Dust the Natural Way"—a publication, fully illustrated, treating on Dust Control, economical road maintenance and methods of application, issued by the Michigan Alkali Company, 60 E. 40th St., New York City.

Dust Laying

213. Full information regarding the use of Solvay Calcium Chloride for effectively laying dust. The booklet, "Solvay Calcium Chloride, a Natural Dust Layer," 24 pages, 5½x8, covers application, economies, etc. Sent without cost. Solvay Sales Corporation, New York.

Guard Rail

26. Accurate cost comparisons in erection of thousands of feet of Tuthill guard rail compared with other types. Everyone contemplating the construction of guard rail should have this data. Tuthill Spring Co., 760 Polk St., Chicago, Ill.

Mixed-in-Place

218. "Mixed-in-Place" bituminous road construction. The construction of low-cost, dustless, mudless roads in a new and better way with the Parsons "Turbo-Mixer." Full details sent promptly by The Parsons Company, Newton, Iowa.

Surface Heaters

220. The "Hotstuf" three in one, combination Tool, Asphalt and Surface heater is described and its use illustrated in Bulletin 6. Mohawk Asphalt Heater Co., 56 Weaver St., Schenectady, N. Y.

Noiseless Manhole Covers

403. Nuisance from loose, noisy manhole covers is eliminated by the use of Westeel rubber cushioned manhole covers and gratings. Six special advantages are explained in a new illustrated bulletin just issued by the West Steel Casting Co., 805 East 70th St., Cleveland, Ohio.

Brick-Paving

230. Full information and data regarding the use of vitrified brick as a paving material, cost, method of laying, life, etc. National Paving Brick Manufacturers' Association, National Press Building, Washington, D. C.

Concrete Curing

235. "How to Cure Concrete," is a manual of instruction on the curing of concrete pavements. 47 pages. The Dow Chemical Company, Midland, Mich.

Gutters

240. "Brick Gutters and Parking Strips." A study dealing with the problems faced in the proper construction of gutters and how they can be overcome. Covers design, construction and results. Well illustrated. Just issued by the National Paving Brick Ass'n, National Press Building, Washington, D. C.

Jacking Culverts

260. No interruption to traffic, and substantial savings in construction costs are the main advantages secured by using the Armco jacking method to install conduits, drainage openings, and passageways under streets, highways and railroads. "The Armco Jacking Method," describing this modern means of construction and its many applications, will be sent upon request, by Armco Culvert Mfrs. Association, Middletown, Ohio. Ask for Catalog No. 7.

Sanitary Engineering

Clarifying Tanks

383. Loughlin Clarifying Tanks for the more complete removal of suspended solids from sewage and industrial wastes at lower cost are described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

Cleaning Water Mains

384. How to clean water mains by The National Method, using your local unemployed labor. Full information will be sent at once by The National Water Main Cleaning Co., 50 Church St., New York, N. Y.

Sludge Drying

385. Relatively dry cake sludge in demand for fertilizer is produced by automatic continuous vacuum filters like those used in Milwaukee, Houston, Chicago, Gastonia, N. C., Charlotte, N. C. Write for literature. Oliver United Filters Inc., 33 West 42nd St., New York, N. Y.

Activation and Aeration

390. A booklet of value to sanitary and chemical engineers describes Norton Porous Mediums of bonded fused alumina (strong chemically stable, uniformly permeable) and their use in aeration of water and sewage. Norton Co., Worcester, Mass.

Glass Covers

393. Full details regarding the use of Lord & Burnham Glass-Overs at Middletown, N. Y.; Marion, Ohio; Clevleand, Ohio; Freeport, N. Y.; Kitchener, Canada; West Chester, Pa., and other places are given in bulletins 22 to 33. Sent promptly on request to Lord & Burnham Co., Irvington, N. Y.

Jointing Materials

396. Full details concerning No. 1 Korite for sealing sewer pipe joints so that they will be permanently tight. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Leak Locating Instrument

399. Transmit-O-Phone, an inexpensive, super-sensitive little instrument for locating leaks and defects in pipes, hydrants and meters, is described in an illustrated circular which will be sent promptly by International Metal & Specialty Co., Box 152, Berlin, N. J.

Locator

401. Locating hidden valve and stop boxes is easy if you have a magnetic dip compass. Complete details on use sent promptly by W. F. Sprengnether, 14 No. 9 St., St. Louis, Mo.

Manhole Covers and Inlets

403. Nuisance from loose, noisy manhole covers is eliminated by the use of Westeel rubber cushioned manhole covers and gratings. Six special advantages are explained in a new illustrated bulletin just issued by the West Steel Casting Co., 805 East 70th St., Cleveland, Ohio.

Pipe, Cast Iron

404. Street, sewer and water castings made of wear-resisting chilled iron in various styles, sizes and weights. Manhole covers, water meter covers, adjustable curb inlets, gutter crossing plates, valve and lamphole covers, ventilators, etc. Described in catalog issued by South Bend Foundry Co., South Bend, Ind.

407. New 1934 Handbook of Super-detables and data for the water works man on pipe line construction, weights, and dimensions. 40 pages, handy pocket size. United States Pipe & Foundry Co., Burlington, N. J.

Pipe Forms

409. Making concrete pipe on the job to give employment at home is the subject of a new booklet just issued by Quinn Wire and Iron Works, 1621 Twelfth St., Boone, Ia., manufacturers of "Heavy Duty" Pipe Forms. Sent promptly on request.

Taste and Odor Control

411. How, when and where activated carbon can and should be used to remove all kinds of tastes and odors from water supplies is told in a new booklet just issued by Industrial Chemical Sales Co., Inc., 230 Park Ave., New York, N. Y. 32 pages, table, illustrations and usable data.

Pumping Engines

413. "When Power Is Down," gives recommendations of models for standby services for all power requirements. Sterling Engine Company, Buffalo, N. Y.

Screens, Sewage

417. The simple, automatic Loughlin self-cleaning traveling screen is fully described in a new bulletin just issued by Filtration Equipment Co., 350 Madison Ave., New York, N. Y.

418. Sewage screens (Tark, Brunotte, and Straightline) for fine and coarse sewage; Straightline Collectors for Settling Tanks (Sludge, Scum and Grit), and Mechanical Aerators for activated sludge plants. Link-Belt Company, 910 So. Michigan Ave., Chicago, Ill. Book 642.

420. A useful new bulletin for all those interested in sewage disposal, describing some of their proven equipment such as self-cleaning bar screens, grit conveyors, sludge collectors and shredders, has just been issued by the Jeffrey Mfg. Co., Columbus, Ohio. Includes diagrams and many illustrations.

Screens

424. Water Screen Book No. 1252, describes water screens and gives complete technical information about them. Link-Belt Co., Chicago, Ill.

Sludge Bed Glass Covers

426. Sludge Bed Glass Covers—"Super-Frame." Hitchings & Co., Main Office, Elizabeth, New Jersey. Offer A. I. A. File 101SB, describing glass covers for sludge and sprinkler beds; details, specifications and cost data.

Sludge Incineration

427. "Incineration Ends the Sewage Disposal Problem" is a new booklet describing the C-E Raymond guaranteed odorless and efficient method of sewage sludge drying and incineration. Just issued by Combustion Engineering Co., 200 Madison Ave., New York, N. Y.

428. Disposal of Municipal Refuse: Planning a disposal system; specifications. The production of refuse, weights, volume, characteristics. Fuel requirements for incineration. Suggestions for plant inspection 45 pp., ill. Also detailed outline of factors involved in preparation of plans and specifications. Morse-Boulger Destructor Co., 202 East 44th St., N. Y.

Treatment

429. A new series of bulletins describing their full line of sewage treatment equipment—Fine Screens, Schofield Bar Screens, Vacuum Filters for Sewage Sludge, Decarie Screenings Incinerators, Schofield Bar and Fine Screens, Vacuum Filters for Sewage Filtration and Pneumatic Ejectors for Sewage Screenings—are ready for distribution on request to Municipal Sanitary Service Corp., Room 2703, 155 East 44th St., New York, N. Y.

430. Separate bulletins showing their many lines of sewage treatment equipment will be sent promptly by The Pacific Flush Tank Co., Chicago and New York. The latest is No. 110 describing tray clarifiers.

431. Eliminate sludge bed troubles, forget about weather conditions, odor nuisance, hail insurance and the like. Full details as to how Oliver United Vacuum Filters overcome these problems will be sent to all interested by Oliver United Filters, Inc., 33 West 42nd St., New York, N. Y.

432. Complete information is now available concerning the Putnam system of odorless, non-bacterial sewage treatment. Causes no nuisance and produces saleable by-products. Details sent promptly by A. R. Putnam, Box 185, Benton Harbor, Mich.

433. Collectors and concentrators for modern sewage treatment plants, recent installations, and full data on aerators, and screens. Link-Belt Co., 910 So. Michigan Ave., Chicago, Ill., and Philadelphia.

Road and Street Maintenance

Bituminous Materials

225. A comprehensive manual on the "Use of Emulsions for Street and Highway Construction and Maintenance," discussing types, uses, relative costs, construction details, etc., will be sent promptly on request by Headley Ashphalt Division, Sinclair Refining Co., P. O. Box 73, Marcus Hook, Penna.

226. "Asphalt Surfacing Materials for Low-Cost Roads" is a handy, 28-page booklet illustrating the many types of road surfaces which may be constructed with Texaco asphalt materials. Well illustrated and contains tables of amounts of stone, sand and asphalt required. Sent promptly by the Texas Company, 135 East 42nd St., New York, N. Y.

227. "Asphalt for Every Purpose," a 44-page illustrated booklet describing Stanolind Asphalt products. Standard Oil Co. of Indiana, 910 So. Michigan Ave., Chicago, Ill.

Ave., Chicago, Ill.

228. A new booklet has just been issued by The Barrett Co., 40 Rector St., New York, describing and illustrating the uses of each grade of Tarvia and Tarvia-lithic. 32 excellent illustrations.

229. A new series of concise and authoritative manuals of construction covering the latest developments in road-mix and surface treatment types as well as the standard asphalt pavements. These contain the best that has been developed by study, research and practical application in all types. Manual 1—Road-Mix Types is now ready for distribution. The Asphalt Institute, 801 Second Avenue, New York, N. Y.

229A. Surface Treatment Types, Asphalt Road Construction Manual No. 2. Full details on surface treatments. 14 chapters, 128 pages. The second of those tremendously valuable and handy little manuals put out by the Asphalt Institute, 801 Second Avenue, N. Y. Sent on request.

349. "The Answer to the Snow Removal Problem." It gives full details of the Frink type S snow plow fo rtrucks. Carl Frink, Mfr. of Clayton, N. Y.

Light and Power

500. Blue Streak gasoline, gas and oil burning engines for generators, pumping and standby units, especially suited for municipal power and light plants. Get full details from Climax Engineering Co., 111 West Monroe St., Chicago, Ill.

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For the Engineer's Library

The editors will be glad to assist readers in getting copies of publications mentioned here.

Two Interesting Highway Publications:

"Tractive Resistance" and "Skidding Characteristics of Pavement Surfaces" are two bulletins just issued by the Iowa Engineering Experiment Station, Ames, Ia. The first mentioned, Bulletin 119, is a contribution by R. G. Paustian which treats the relation of tractive resistance to roadway surface types exhaustively in its 64 pages. The second bulletin contains 128 pages, and is a contribution by R. A. Moyer. It is also exhaustive and contains much information of value to the highway engineer. No information is given regarding the price of these publications. We presume that copies are available on request, so long as they last.

Distribution of Soil Pressure Beneath Footings:

Describes recent investigations of distribution of soil pressure beneath footing of a column 19 feet square. Observations recorded over a period of 18 months. Pressure is shown to be a maximum under center and decreases to almost zero at edges. 16 pages. Free. Texas Engineering Experiment Station, College Station, Texas.

Filtrations in Chemical Laboratories:

A hand book on filtering operations for the chemist; covers metallurgical plants; chemical works; bacteriological pathological and general laboratories; food products; agricultural chemistry; oil, sugar, molasses, rum, brewery, gas, leather, fertilizer, etc. 135 pages. Free on request, we believe, to Carl Schliecher & Schull Co., 167 East 33rd St., N. Y., manufacturers of filter papers.

Filters for Sewage Sludge:

Vacuum filtration methods and equipment are described and discussed in detail in Bulletin 203A, recently issued by Oliver United Filters, Inc., 33 West 42nd St., N. Y. This bulletin covers industrial equipment and methods primarily. A special sanitary bulletin treats of continuous mechanical dewatering of sewage sludges. Either or both sent on request.

Floor Surface Treatment:

A newly perfected surface hardening treatment for floors has been announced by Stonhard Co., 401 N. Broad St., Philadelphia, Pa., details and data on which will be sent on request.

Incineration of Sewage Sludge:

This an 8-page booklet which, while describing the Nichols-Herreshoff sludge incinerator principally, also gives information of value to the engineer interested in this phase of sanitary engineering. Sent on request. Nichols Engrg. & Research Corp., 40 Wall St., New York.

Monel Metal in Sewage Treatment:

Mimeographed; 8 pages. Information regarding places where non-corrosive metals should be used in sewage treatment plants, and also complete technical information on monel metal, strength, yield point, elongation, composition and usual mill forms. Sent on request. International Nickel Co., 67 Wall St., New York, N Y.

Cement and Concrete Reference Book—1934:

Lots of information on the Portland Cement industry: production; use per capita by states; distribution of uses, as for roads, alleys, dams, etc.; yardage of concrete pavements, and of roads; mileage of all types of improved roads; and road maintenance costs. Sent on request to Portland Cement Association, Chicago, Ill.

Fishing and Drilling Tools:

Not for the fisherman, but for the blast hole driller. Liberally illustrated, with tool data clearly presented and the actual prices of each item shown. Also gives instructions for sharpening bits, tempering, splicing cables, data on casing and pipe, and other hand-book material for the churn-type drill operator. Copy on request to Bucyrus-Erie Co., So. Milwaukee. Wis.

Manual on Concrete Curing:

An excellent 56-page text on curing concrete. Special attention is given to curing with the use of calcium chloride. Specifications for calcium chloride are given, also charts on compressive strengths, volume changes and flow tests; tables on surface curing; data on concrete bases. Practical points for cold weather concrete work. Free on request to Columbia Alkali Corp., Barberton, Ohio.

Control Valves in Water and Sewerage Plants:

"Successful experiences in Municipal Waterworks, Filtration and Sewage Disposal Plants" is the title of a booklet describing the many uses of Cutler-Hammer electric control for valves and other equipment. 14 pages. Free. Cutler-Hammer, Inc., Milwaukee, Wisc.

Jaeger Equipment:

An excellent 40-page booklet describes the Jaeger construction equipment: Pumps; mixers, 3½S to 56S; bituminous mixers; hoists; concrete placing equipment; truck mixers; and road machinery, including vibro-spreaders, blacktop pavers, finishers, form tampers, forms and many other items. Sent on request to Jaeger Machine Co., Columbus, O.

Grinding Wheels:

This excellent 60-page booklet covers the following: General information on grinding wheels; wheel specifications; Norton wheel markings; selection of wheel specifications; influential variable factors; such as speed of wheel, skill of workman, etc.; grain size, grade, structure and bond; tabular recommendations; operating rules and general data; table of speeds; dressing and trueing wheels. Sent on request to Norton Co., Worcester, Mass.

Rigid Frame Concrete Bridges:

A new edition of "Analysis of Rigid Frame Concrete Bridges" has been published. This edition has been enlarged by adding many new features and results of recent studies. In addition to analysis by moment distribution, a new chart and a new formula are given as basis of a procedure by which moments may be determined quickly without use of frame analysis. This new procedure is valuable for use in making preliminary designs or in checking moments obtained by frame analysis. A simple method of correcting moments in frames by allowing for deck curvature is presented, and important structural detail used in rigid frame concrete bridges are added. There is also a new convenient method of determining stresses in double-reinforced concrete sections subject to combined bending and axial thrust. The presentation is brief but clear and complete enough to enable designers of bridges to analyze rigid frame bridges quickly. Copies of this 40-page booklet are available by writing to the Portland Cement Association, 33 West Grand Avenue, Chicago, Illinois.

Material Prices

(Published for information only)

(Dec. 29, 1934)

Warehouse Prices on Reinforcing Steel and Structural Shapes

	Structural Shapes	*New Billet Reinforcing Bars*
New York	3.37c	2.82
Boston	3.52	—
St. Louis	3.44	—
Cincinnati	3.40	3.25
Pittsburgh	3.15	2.90
Chicago	3.20	2.10
Philadelphia	2.95	2.955
Cleveland	3.16	2.60
San Francisco	3.55	3.50

Prices on cast iron pipe, net per ton, Class B, 6-inch and larger, AWWA specifications*

Boston	$47.50	Baltimore	$45.50
New York	44.90	Atlanta	42.00
Chicago	46.00	Birmingham	38.00
Minneapolis	48.50	Kansas City	48.15

Burlington, N. J., $42.00; extra price for 4-inch, $3.00 per ton; extra for Class A, $3.00 per ton.

**Information, courtesy U. S. Pipe & Foundry Co.*

Warehouse Prices on American Pig Lead

Per pound

New York	4.37½ to 5.37½
Cleveland	4.70 to 4.75